August 4, 1958

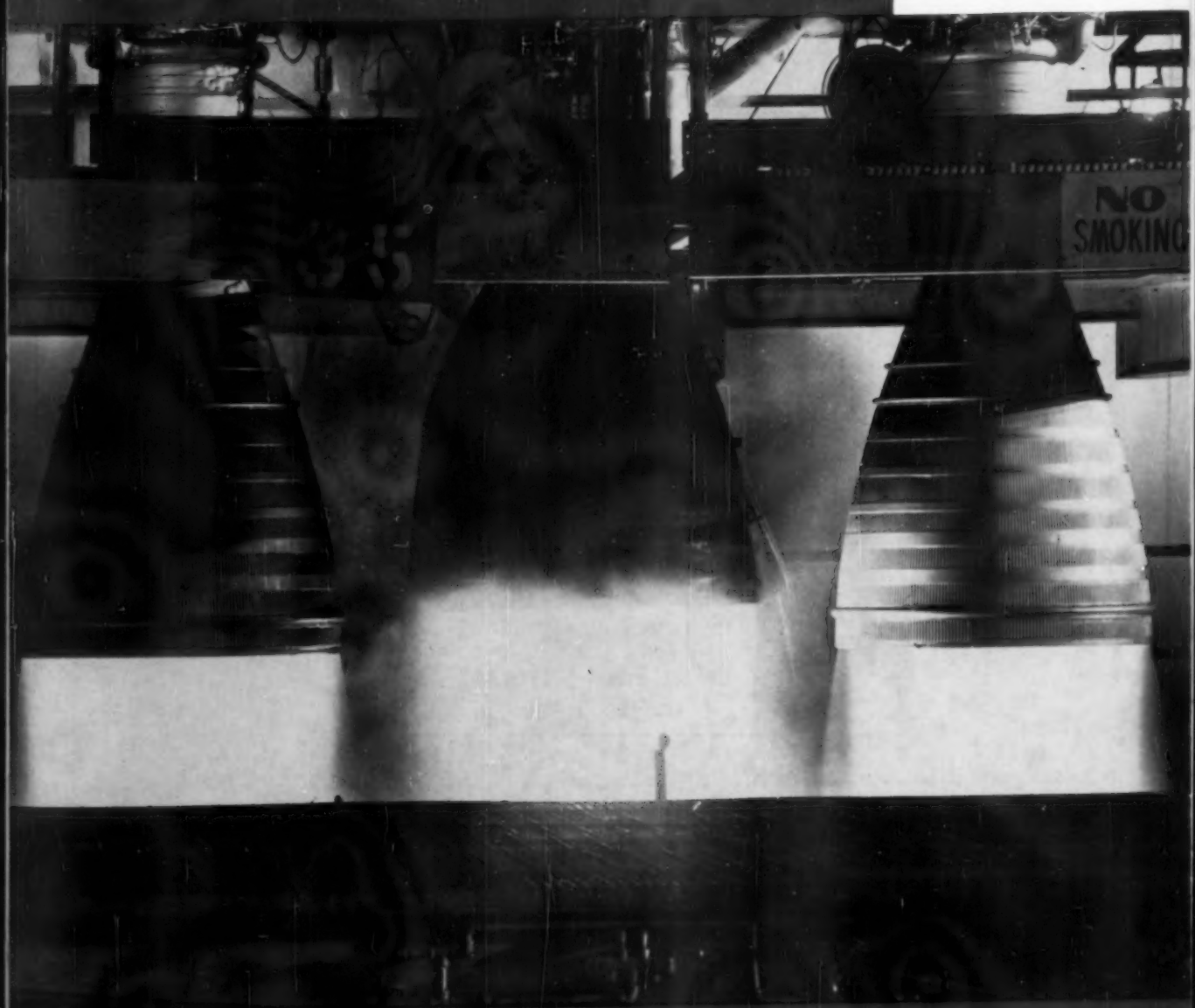
Aviation Week

Including Space Technology

75 cents

A McGraw-Hill Publication

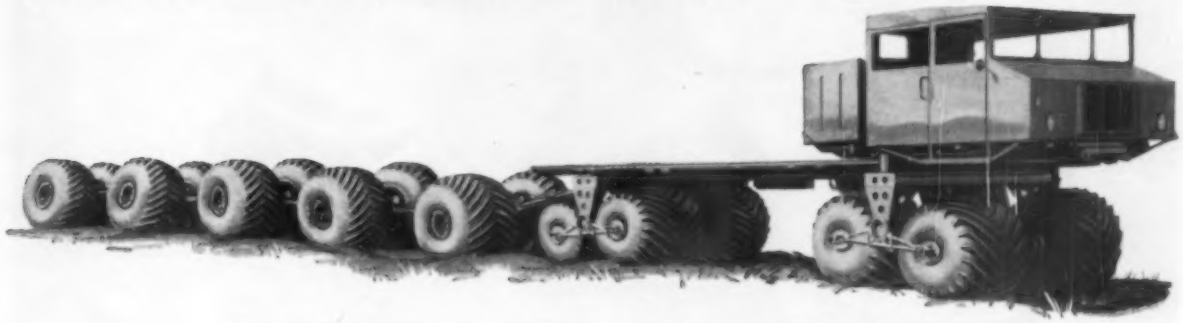
USAF Changes Philosophy On Flight Testing



Rocketdyne Engines for Atlas 'B'

Bomarc Sales Drive Focuses on NATO Nations

5,000 GALLONS OF FUEL—ROLLING IN UNIQUE TIRE-LIKE CONTAINERS CALLED ROLLI-TANKER—ARE CAPABLE OF FOLLOWING AMAZING "GO-ANYWHERE" TIRES INTO HERETOFORE **IMPASSABLE** AREAS!

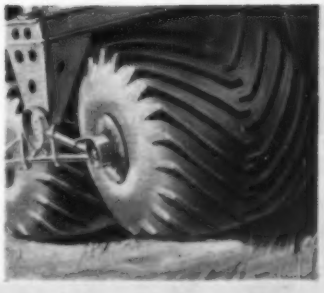


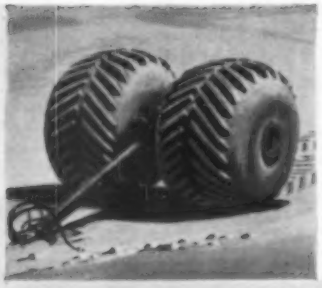
ROLLI-TANKER TERRA-TIRE

LET YOUR PROJECT UTILIZE THIS AMAZING

mobility

Wide Ground Contact Area of the axle-driven Terra-Tire by Goodyear can traverse sand, mud, marshland, snow and roughest going without falling. Principle lends "go-anywhere" mobility to vehicles—and liquids.





Filled with fuel, these Rolli-Tanker units—mounted in pairs and available in sizes with filled capacities of from 140 to 500 gallons each—can travel most anywhere! Tow-bar units can be equipped with own filling, emptying, braking systems.

Float fuel ashore—the Rolli-Tanker makes it no problem to get bulk fuel or liquid supplies ashore. No costly pumping or long-line hoses needed with this new Goodyear advance.

Fuel ready, where needed—this unique system is easily the most foolproof answer to needs for mobile fuel supplies. An advanced Goodyear development for national defense.

For details contact: Goodyear, Aviation Products Division, Dept. T-1715, Akron 16, Ohio.

GOODYEAR
AVIATION PRODUCTS

Terra-Tire, Rolli-Tanker—T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

BRUNSWICK "NOSES" ARE PRESSING THE THERMAL BARRIER

Countless eyes in the technical research world today are focused on the Strickland B Process, exclusive with Brunswick. This is a fully mechanical method of producing reinforced fiberglass laminates. Recent experiences with it indicate a bright area of promise in meeting the problems involved in re-entry.

Much current interest centers on an SBP produced radome's ability to withstand under stress a high temperature jet stream for a substantial number of minutes. Yet this is only indicative of many new areas under relentless and costly attack by highly skilled Brunswick research and development teams.

New Brunswick materials and techniques are also available to answer your problems in design, fabrication and testing of aircraft components in metal honeycomb and conventional metalwork. Write: The Brunswick-Balke-Collender Co., Defense Products Div., 1700 Messler St., Muskegon, Michigan.

BRUNSWICK

MAKES YOUR IDEAS WORK

AVIATION CALENDAR

Aug. 6-8—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 7-8—Annual Conference, American Society for Quality Control, Western Region, El Cortez Hotel, San Diego, Calif.

Aug. 7-9—National Convention, OX5 Club of America, Hotel Statler, Los Angeles.

Aug. 7-15—Modern Developments in Heat Transfer, Continuation Course, University of Minnesota, Minneapolis, Minn.

Aug. 13-15—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder Laboratories, Boulder, Colo. Sponsored by NBS, American Institute of Electrical Engineers and Institute of Radio Engineers.

Aug. 13-15—Seventh Annual Conference, Industrial Applications of X-ray Analysis, Albany Hotel, Denver, Colo.

Aug. 14-23—Ninth All-Women's International Air Race, Ontario, Canada to West End, Grand Bahamas.

Aug. 17-23—Missiles Operations Research, Engineering Seminar, Pennsylvania State University, University Park, Pa.

Aug. 18-19—Annual Western Regional Meeting, American Astronautical Society, Dinkelspeil Auditorium, Stanford University, Palo Alto, Calif.

Aug. 19-22—Pacific General Meeting, American Institute of Electrical Engineers, Hotel Senator, Sacramento, Calif.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 25-27—Third Annual Convention, National Flying Club Assn., Hollywood Roosevelt Hotel, Hollywood, Calif.

Aug. 25-29—Second Symposium on Naval Hydrodynamics, Washington, D. C.

(Continued on page 6)

AVIATION WEEK Including Space Technology

August 4, 1958
Vol. 69, No. 5

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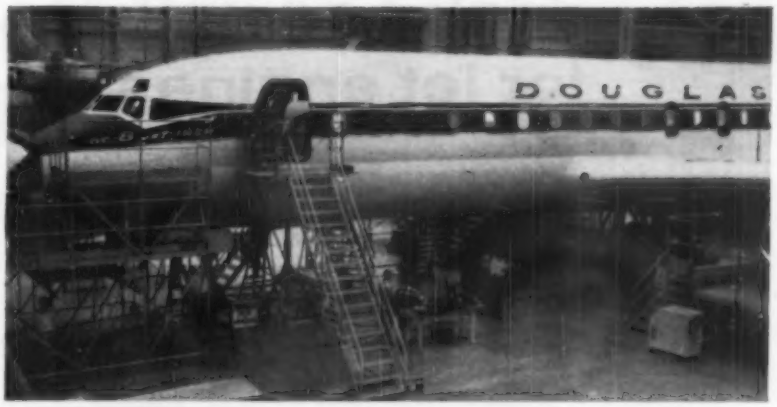


HOW Blind Nuts* SAVE MANHOURS ON THE DC-8

BN360 BLIND NUT

The Blind Nut was selected by cost conscious Douglas engineers for use as a nutplate to attach the diaphragm seal retainer strips on all exterior passenger doors and emergency exit jambs of the cabin-pressurized DC-8 luxury airliner because of its simpler and faster installation.

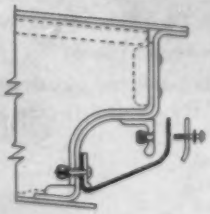
Each Blind Nut is installed in a single hole, in one operation and at a rate of about ten per minute compared to two additional countersunk holes required for the installation of two rivets to attach each nutplate.

Considering that each door on the DC-8 uses several hundred or more Blind Nuts, a substantial number of manhours will be saved on each production airplane when compared to the additional drilling and riveting time required to install conventional nutplates.

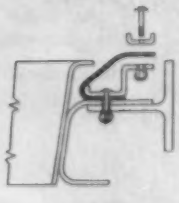
Stainless steel Blind Nuts are being used on aircraft and missiles in temperatures up to 800° F. in production and repair applications. They are quietly installed with a hand-held, hydraulically actuated gun. Blind Nuts are available in grip lengths of 1/16" increment and range in screw sizes from 4-40 through 3/8-24.

Write for additional Blind Nut data.

U. S. PATENT PENDING. FOREIGN PATENTS GRANTED AND PENDING *TRADEMARK

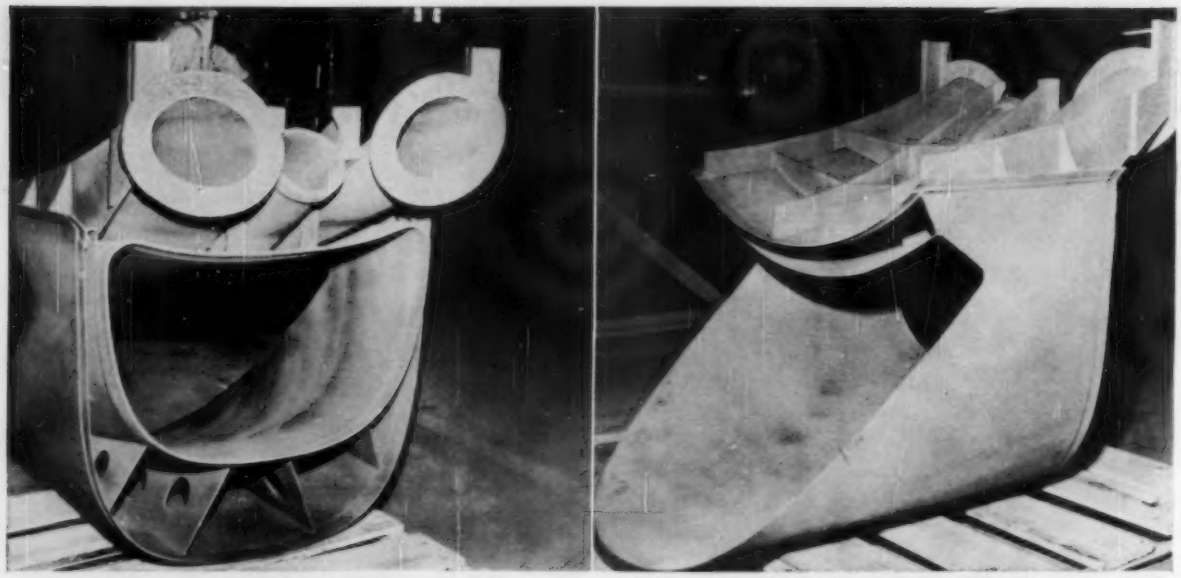


EXTERIOR PASSENGER DOOR INSTALLATION



EMERGENCY EXIT DOOR JAMB INSTALLATION

hi-shear RIVET TOOL COMPANY
2600 WEST 247TH STREET • TORRANCE, CALIFORNIA



Engine air scoop casting made by R. H. Osbrink Mfg. Company, Los Angeles

MAGNESIUM "SUGAR SCOOP" HELPS REGULUS II BREATHE

Huge thin-wall magnesium casting satisfies appetite for air

At supersonic speeds more than ten miles above the earth, Chance Vought Aircraft's Regulus II consumes enormous quantities of air through a 150 lb. magnesium casting.

This complex, close tolerance magnesium casting supplies air for the Regulus' powerful J-79 jet engine. It also provides ducting for boundary layer control and for air conditioning. Nominal thickness on walls and webs is 0.24 inch and the solid leading edge tapers to a 0.015 inch cast radius. Casting tolerance is + or −0.03 inch on dimensions up to 12 inches, with an additional + or −0.002 inch per inch on dimensions above that. That's real casting accuracy!

This air scoop is an excellent example of the versatility and usefulness of magnesium alloy castings in aircraft design. Thin-wall casting designs can be produced in magnesium to replace complicated, costly fabrications involving several production operations.

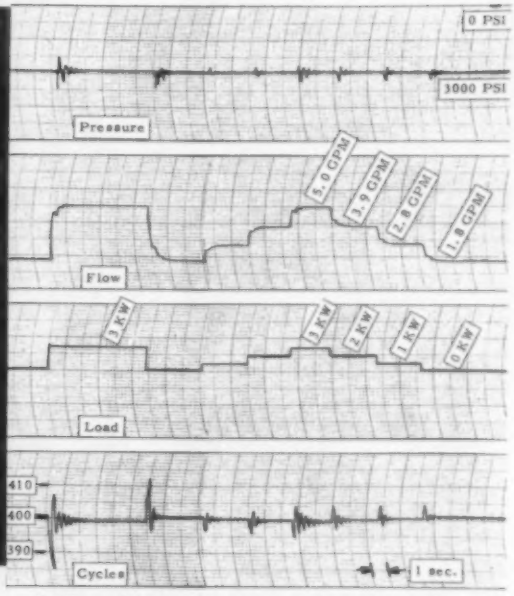
For more information about magnesium sand castings and their use in aircraft design, contact your nearest magnesium foundry or Dow sales office.

MAGNESIUM DESIGN, a 235-page handbook, discusses in detail: properties, structural design, product design including castings and mill products, fabrication and finishing. Large section of tables on properties, sizes, tolerances, etc. For your copy contact a Dow sales office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1463K-1.

YOU CAN DEPEND ON DOW

New Electrical Power System for Missiles and Aircraft

Sundstrand Controlled-Speed Motor integrated with alternator provides minimum weight and envelope. Leland Electric's alternator is shown here.



Oscillograph trace of power-generating system performance with basic flyball governor. Governor trimming methods provide more precise control.

Operates off general hydraulic system, provides 4 kva rated power, capable of 100% overloads

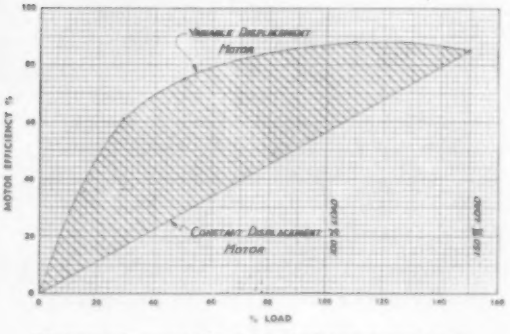
Use of a Sundstrand controlled-speed, variable-displacement hydraulic motor to drive a 400-cycle alternator provides an emergency and isolated electrical power-generation system with many desirable characteristics.

High efficiency throughout the operating range is assured because speed of the motor is controlled by varying the displacement to match the required torque output. The motor takes only that flow of oil from the general hydraulic system required to maintain the driven load. This eliminates the inefficient throttling necessary in a fixed-displacement motor system. There are no discontinuities in speed control from no load to full load.

The system is capable of handling 100% overloads for extended periods.

Integration of the motor in a common housing with the alternator provides minimum weight and envelope . . . maximum resistance to shock and vibration . . . and increased reliability. The integrated package also permits cooling the alternator with oil when air cooling is impractical.

The motor shown has a self-contained flyball governor. Models with external speed controls are available where variable speed is required. The motor itself is particularly suited to driving any load where torque requirements are variable and heating of hydraulic fluid is critical.



Efficiency advantage of variable-displacement motor over fixed displacement motor is shown for loads ranging from 0 to 150% of rating.

- 4 kva with 1.0 power factor
- -65° F to +275° F temperature range
- Higher temperature models available
- Speed control within ±1/10% with trim
- ±1½% with self-contained governor
- One-second transient response

SUNDSTRAND

SUNDSTRAND AVIATION

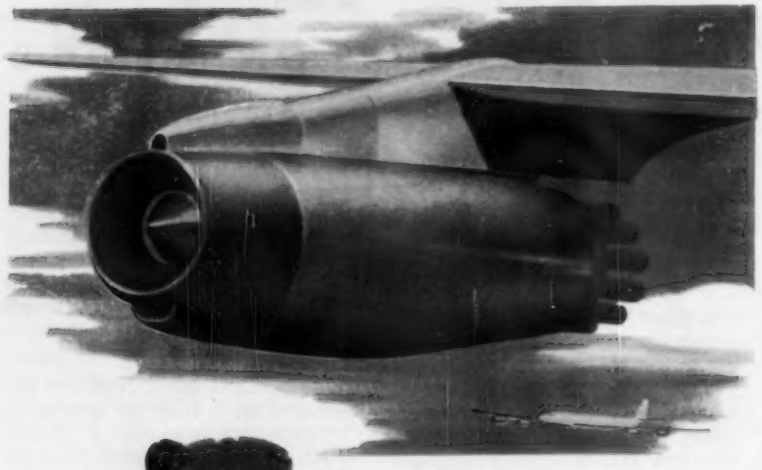
Division Sundstrand Machine Tool Co.
2411 Eleventh St., Rockford, Illinois

District Offices in: Arlington, Texas; Hawthorne, California; Rexdale, Ontario; Rockford, Illinois; Seattle, Washington; Stamford, Connecticut; Washington, D.C.

designed for jet engines

...CEC's economical vibration pickups

Wherever vibration is present—on jet engines, machinery, motors, or generators—CEC's new line of low-cost vibration pickups find ready application. Featuring *constant damping* over the operating temperature range of −65°F to +500°F, the omnidirectional 4-123 and its horizontal and vertical counterparts (4-121 and 4-122) perform with precision in oily or corrosive atmospheres. Sand, dust, or fungus cannot penetrate their hermetically-sealed interiors.



The 4-123, with its 45-2000 cps operating range, is ideal for jet-engine monitoring where the lowest frequency encountered is approximately 50 cycles. The 4-121 and 4-122 monitor turboprop vibrations in the range of 15 cps to 2000 cps. Each type weighs only 4.25 ounces including connector. For additional information, call your nearest CEC sales and service office, or write for Bulletin CEC 1596-X2.

Transducer Division CEC

Consolidated Electrodynamics

300 North Sierra Madre Villa, Pasadena, California

RECOGNIZED LEADER IN GALVANOMETERS—TELEMETRY, PRESSURE AND VIBRATION INSTRUMENTATION

AVIATION CALENDAR

(*Continued from page 5*)

Aug. 25-30—Ninth Annual Congress, International Astronautical Federation, Amsterdam, Holland.

Aug. 30-Sept. 1—Annual One-Design Sailplane Regatta, Harris Hill, Elmira, N. Y.

Aug. 31-Sept. 1—Air Race, Professional Race Pilots Assn., Ft. Wayne, Ind. For details: Don Berliner, 18 Hudson Ave., Athens, Ohio.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 2-12—Problems of High-Powered Radar Design, Summer Program, Massachusetts Institute of Technology, Cambridge, Mass. (Security clearance required.)

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

Sept. 9-11—Second National Conference on Applied Meteorology: Engineering, Ann Arbor, Mich. Program Chairman; Dr. D. J. Portman, 5500 East Engineering Bldg., University of Michigan, Ann Arbor, Mich.

Sept. 11-12—Annual Business Meeting and Conference, Northeast Chapter, American Assn. of Airport Executives, Municipal Airport, Worcester, Mass.

Sept. 15-18—Fall Meeting, American Rocket Society, Inc., Hotel Statler, Detroit.

Sept. 15-19—Annual Instrument-Automation Conference & Exhibit (International), Instrument Society of America, Philadelphia Convention Hall, Philadelphia, Pa.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla.

Sept. 22-24—1958 Convention of the National Business Aircraft Assn., Bellevue Stratford Hotel, Philadelphia, Pa.

Sept. 25-27—Fifth Annual National Western Forum, American Helicopter Society, Ambassador Hotel, Los Angeles, Calif.

Sept. 25-28—Air Force Assn. Annual Convention and Airpower Panorama, Dallas.

Sept. 29-Oct. 3—National Aeronautical Meeting, Society of Automotive Engineers, Inc., the Ambassador, Los Angeles.

Sept. 29-Oct. 3—Semi-Annual Meeting and Western Tool Show, American Society of Tool Engineers, Shrine Exposition Hall, Los Angeles, Calif.

Oct. 1-3—National Airports Conference, University of Oklahoma, Norman, Okla. Co-sponsored by American Assn. of Airport Executives and the CAA.

Oct. 7-8—1958 Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Chateau Laurier, Ottawa, Canada.

Oct. 15-17—Twelfth Annual Meeting, Southeastern Airport Managers' Assn., The Palm Beach Terrace, Palm Beach.

Oct. 22-24—Fifth National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

LEAR NAFLI DIRECTOR *(top)*
LEAR SITUATION INDICATOR *(bottom)*

You'll love L-I-F-E* *even more–*

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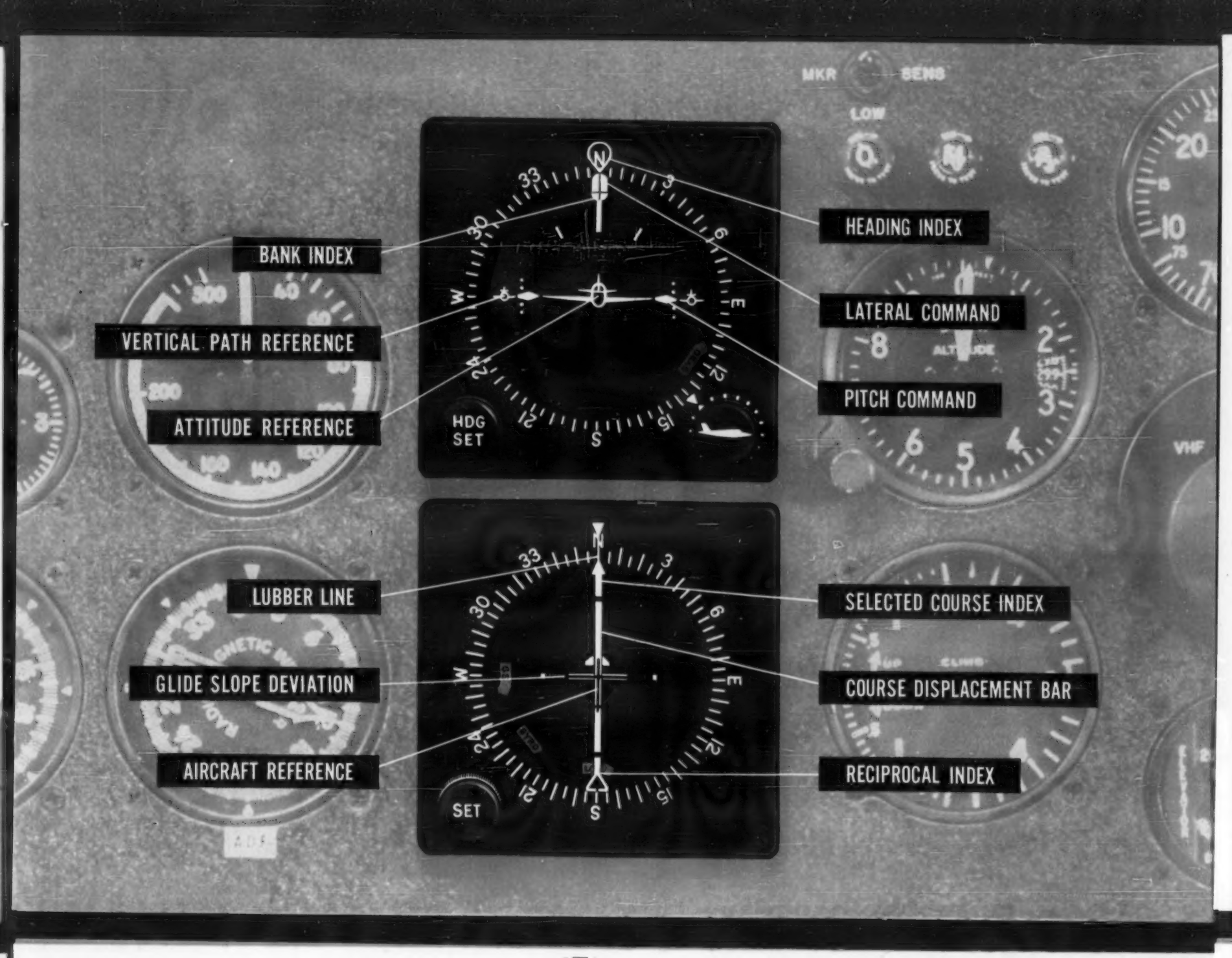
L-5/LIFE AUTOPILOT CONTROLLER

SIMPLE PUSH-BUTTON CONTROL

HEADING MODE—provides smooth automatic maneuvering onto a selected heading with correct bank and intercept approach angles.
CAPTURE MODE—introduces gradual interception and "capture" of selected VOR or Localizer course.
TRACKING MODE—adds automatic cross-wind compensation to maintain center of VOR or Localizer course after "capture."
ALTITUDE MODE—controls airplane to maintain altitude at barometric value existing when mode is selected.
GLIDE SLOPE MODE—commands autopilot to intercept smoothly and "lock" on the Glide Slope.

LC-53

*LEAR INTEGRATED FLIGHT EQUIPMENT *plus* L-5 AUTOPILOT*

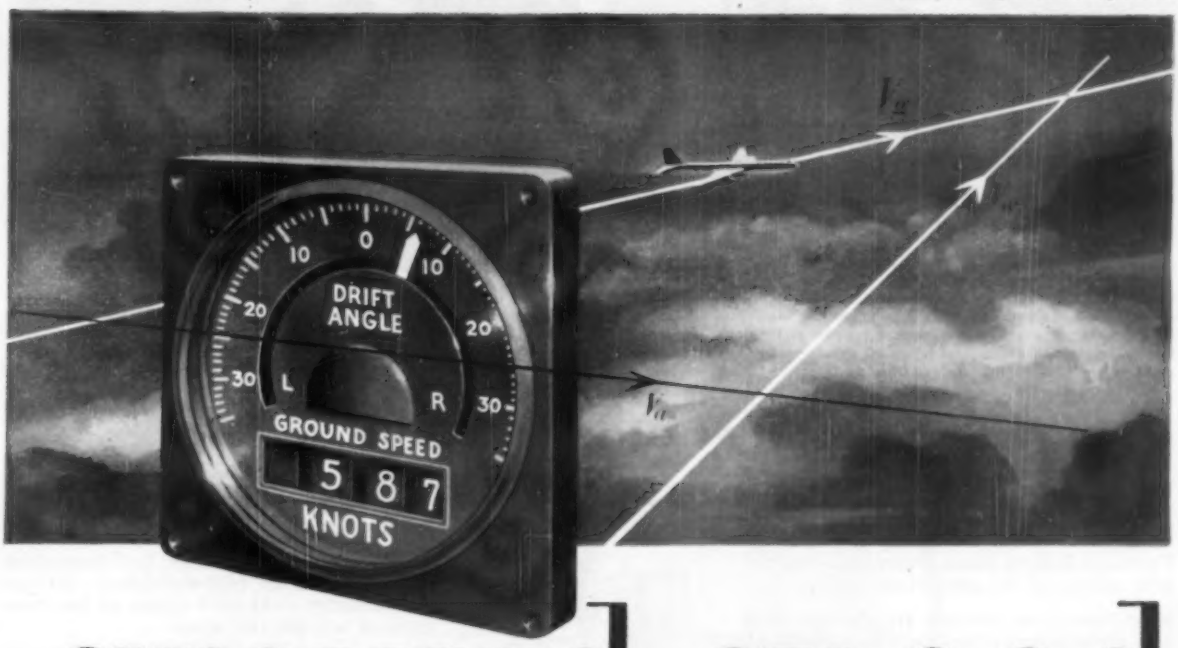

BANK INDEX
VERTICAL PATH REFERENCE
ATTITUDE REFERENCE
HEADING INDEX
LATERAL COMMAND
PITCH COMMAND
HDG SET
LUBBER LINE
GLIDE SLOPE DEVIATION
AIRCRAFT REFERENCE
SET
SELECTED COURSE INDEX
COURSE DISPLACEMENT BAR
RECIPROCAL INDEX

One of GPL's ground speed and drift angle measuring equipments, AN/APN-81, provides basic input information to computers which tell Air Force WB-50s exactly where they are every flight second.

GPL auto-navigators give an instantaneous and continuous display: Ground Speed and Drift Angle; Wind Speed and Direction; Longitude and Latitude; Shortest Course-To-Destination; Steering Signal To Pilot (or autopilot).

The systems were developed for the Air Force (WADC). They are the result of an achievement comparable in magnitude to the breaking of the sound barrier: GPL's harnessing of the Doppler-effect to air navigation.

The benefits of these GPL systems extend to every area of flight. Their vast potential has just begun to be explored.



ground speed & drift angle

ANY TIME, ANYWHERE, ANY WEATHER

One look and the pilot KNOWS. At a glance, he reads actual ground speed and drift angle, displayed on his flight panel – automatically, accurately, and continuously.

How? Through the famous RADAN* family of self-contained GPL Doppler auto-navigators, recently released for civilian use.

For civilian aircraft, RADAN systems mean pinpoint navigation, reliability, savings in precious time and fuel, a priceless margin of safety. In its wide and growing applications for the military, RADAN provides all these, and continuous velocity data as well.

GPL systems have behind them many millions of operational miles in transcontinental, oceanic and polar flight. RADAN systems herald a new era of faster, safer, more economical civilian flight.

RADAN is ready and available *now* to everyone.

GPL | GPE GENERAL PRECISION EQUIPMENT CORPORATION

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ENGINEERS – GPL achievements have opened up some unusual research and development opportunities. Send resumé to Personnel Manager.

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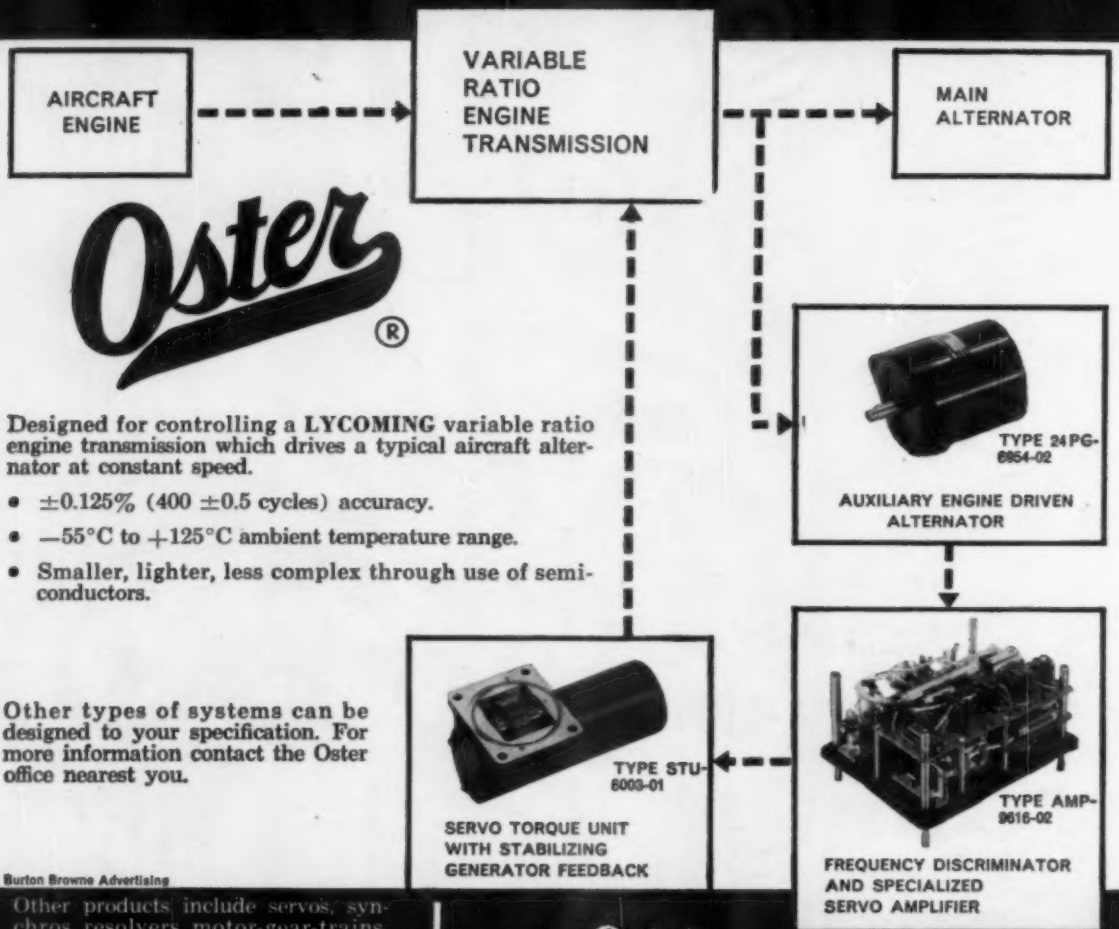
FREQUENCY DISCRIMINATOR AND SERVO DRIVEN CORRECTION LOOP

±0.5 ~ accuracy



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- **±0.125% (400 ±0.5 cycles) accuracy.**
- **—55°C to +125°C ambient temperature range.**
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Other types of systems can be designed to your specification. For more information contact the Oster office nearest you.

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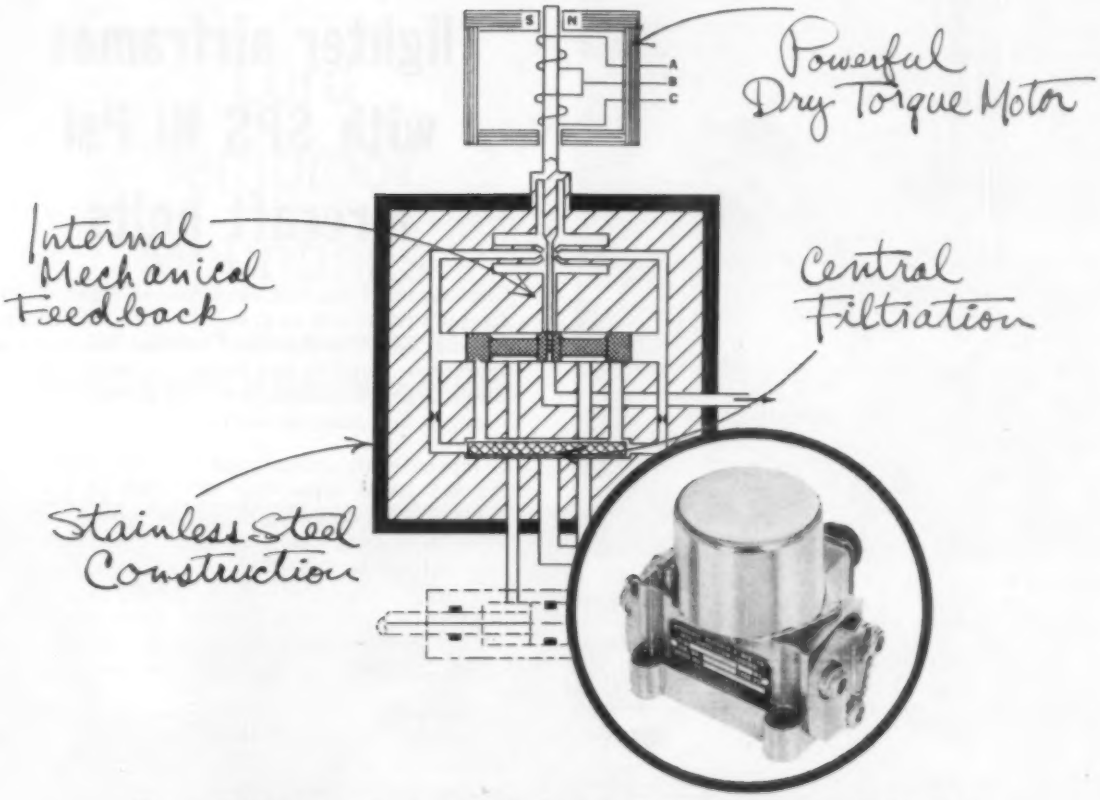
Engineers For Advanced Projects: Interesting, varied work on designing transistor circuits and servo mechanisms.
Contact Mr. Robert Burns, Personnel Manager, in confidence.

HYDRAULIC RESEARCH

*The originator of the Dry Torque Motor Servo**

Presents



A NEW SERVO TRANSDUCER FOR HIGH PERFORMANCE CONTROL

Designed for Electro-Hydraulic flow, pressure, or power control up to 40 Hydraulic horse power, with performance peaks never before obtained in a production unit.

EXCEPTIONAL NULL BALANCE, NO ADJUSTMENT REQUIRED, AND ESSENTIALLY UNAFFECTED BY:

VIBRATION to 100g's
TEMPERATURES —65°to +450°F
ACCELERATION to 100g's

HYSTERESIS less than 3% **THRESHOLD** less than .5%

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Subsidiary of Bell Aircraft Corp.
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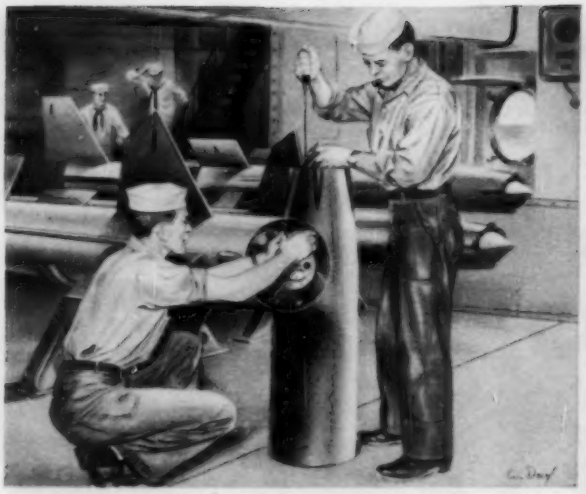
*Thousands of the original Dry Torque Motor servo valves are now in use by aircraft, propulsion and missile manufacturers.



MISSILE COMPONENTS Bulova safety and arming systems protect ground, air and sea crews from load to launch, then take over in flight. Safety factor of one in a million is specified and reliably delivered by Bulova's precision production facilities. Powder-driven gyros and fuzing systems are among other Bulova developments for 18 key missiles.

AIRCRAFT INSTRUMENTS Bulova's new Servo Altimeter assures maximum reliability through unprecedented sensitivity, accuracy and repeatability. At 40,000 feet, it detects 4-foot changes . . . is correct to 40 feet. Safety is improved in traffic control and flight over difficult terrain. As a control instrument, it is readily adaptable to guided missiles.

Bulova reliability helps to solve today's most challenging problems

For more than 80 years, Bulova has charted new courses in the area of reliability.

Milestones along the way are the electronic and electro-mechanical devices created by the Bulova capability—the uncommon blend of pioneering vision and precision production experience.

These Bulova developments, distinguished by their advanced design and consistent high performance, help our nation's defense and industry stake solid claims on the frontiers of science and space.

The high degree of Bulova reliability prevails from concept to mass production. For assistance with your systems and components problems, write: *Department G.I.S. 3, Bulova Park, Jackson Heights, New York.*

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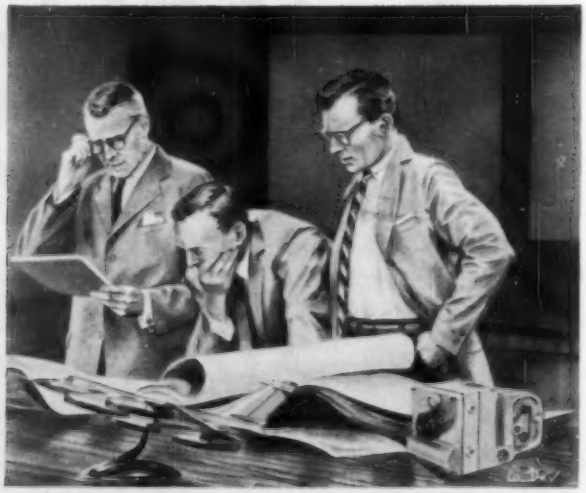

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Center Flange Temproof Mounting
MS-91404-S1 mounting base assembly incorporates Temproof Mountings.

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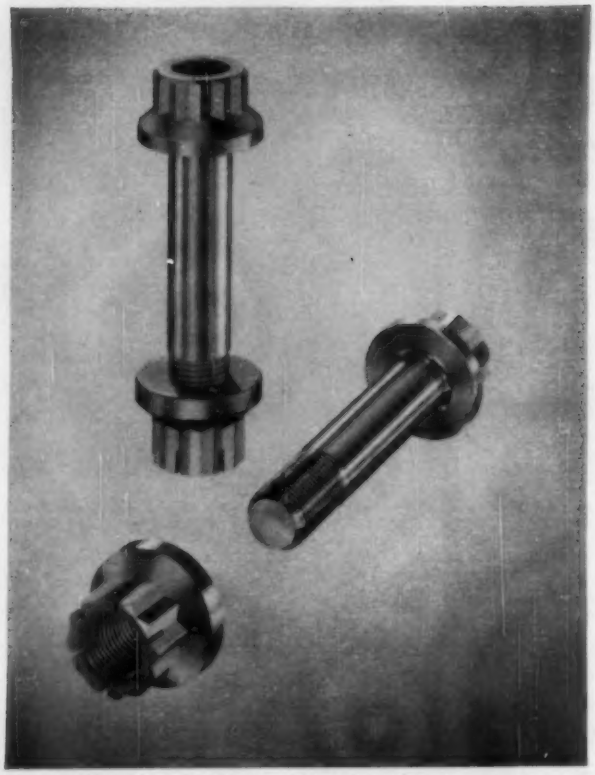
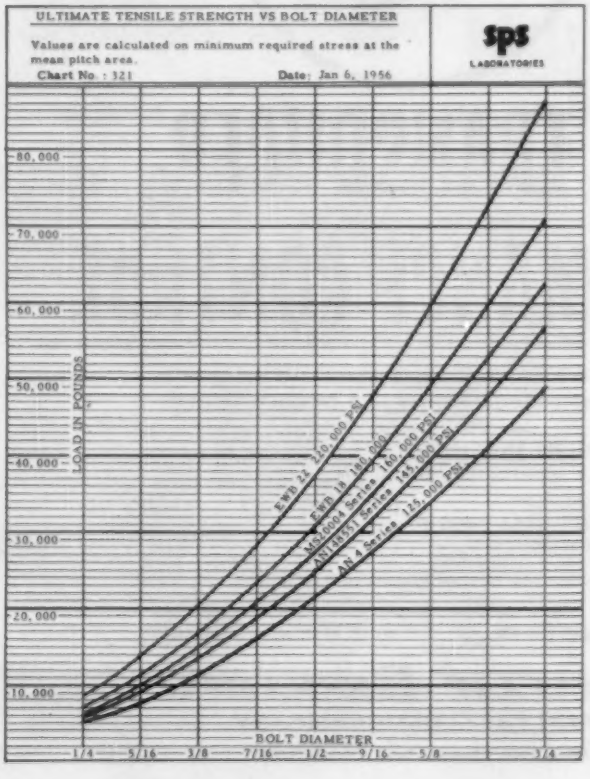


Hi Psi EWB-22 bolt. External wrenching head with increased bearing area permits greater loading without indentation of bolted surface. Hi R thread form, generous fillet under head, smooth overall surface increase tensile and fatigue strength. The EWN-22 locknut was designed with characteristics specially suited to the bolt.



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EWB-22 is much stronger than conventional aircraft bolts. These curves, with ultimate tensile strength in pounds plotted against bolt diameter, show that it is feasible to replace an MS 20004 bolt with an EWB-22 one size smaller. The EWB-22 is stronger in shear and in fatigue as well.

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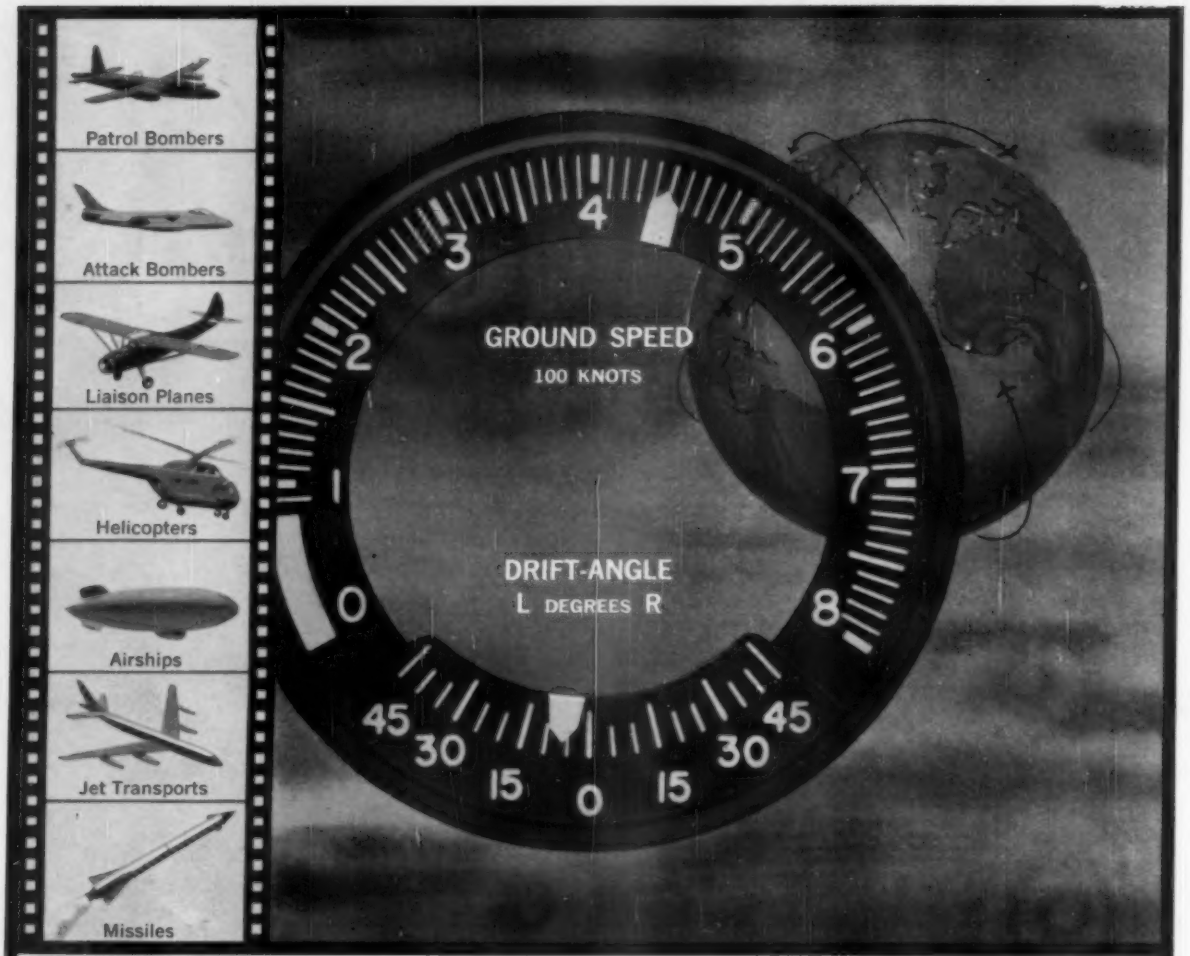

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MOST COMPACT—Inherent simplicity of CW radar systems plus the ingenuity of RANAV design has enabled Ryan to take most advantage of subminiaturization and transistorization, creating compact systems with advanced modular units and etched circuitry.

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August 4, 1958

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▶ Air Force probe, first of USAF-Army series, now planned for Aug. 17; Russian May 1 attempt fails.

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▶ Carrier to buy 25 Convair model 600s and 25 Boeing 707-023s; to lease engines from three manufacturers.

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▶ Company has briefed military teams from France, Germany and Sweden; concentrates sales campaign on lethality at low cost.

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COVER: Propulsion system for the USAF Atlas-B intercontinental ballistic missile undergoes a full-power test at the main plant, Canoga Park, Calif., of Rocketdyne, a division of North American Aviation, Inc. Slight distortion in sustainer engine nozzle (center) is caused by gimbaling of the engine. Sustainer engine is rated at 60,000 lb. thrust; twin-chambered booster engine (nozzles on each side) is rated at 330,000 lb. total thrust (AW July 28, p. 22).

PICTURE CREDITS:

COVER—Rocketdyne; 30—United Press; 30 (top)—U. S. Army; 51—National Research Corp.; 41, 59—Convair; 62, 63—Aviation Week; 63 (left)—Boeing; 67—de Havilland; 69—Bell Telephone Laboratories; 76, 95—Bell Aircraft Corp.; 95 (top)—Sikorsky; 102—British Petroleum.

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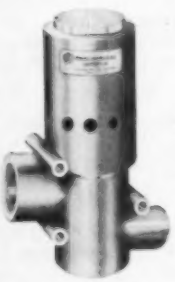

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EDITORIAL

Mid-Summer Survey

The aviation industry and its related technologies are steaming through the mid-summer months in one of the strangest atmospheres since the first years after the end of World War II.

The Mid-East crisis simmers dangerously close to a shooting war in strange contrast to a domestic calm and complacency that is hard to explain.

Although U.S. science and industry are on the verge of some of their most exciting explorations of space, the general public appears bored with the entire subject.

The industrial structure on which the Pentagon depends to develop and produce superior new weapon systems is creaking and groaning under severe financial stress but even the top civilian leaders in the Defense Department, most of them former business executives, are strangely indifferent to this problem or its implication for future defense strength.

Burning Issues

In contrast the Congress has recorded a remarkable record during the session now drawing to a close on Capitol Hill in handling the burning issues of space technology, missile and advanced aircraft development and the sticky problems of air traffic control and air safety regulation. We cannot recall another session of Congress that has taken so much positive action on these perennial problems.

Perhaps the most important achievement in this field was the creation of the National Aeronautics and Space Agency using the technicians and laboratories of the National Advisory Committee for Aeronautics as a nucleus. In the relatively short time of four months the House and Senate, with a fine bi-partisan spirit, tackled the national space agency proposals submitted by President Eisenhower and have forged an instrument capable of executing a sustained national program in this vital area. We have been particularly impressed by the manner in which the special House Committee, headed by Majority Leader John McCormack of Massachusetts with the aid of a good professional staff, guided this program through what might have been a legislative morass and fought vigorously for the most effective compromise with a rather odd Senate approach to the problem. Sufficient starting funds have been made available for the new agency in the current fiscal year. If President Eisenhower will now make the key appointments of the director and the required new council members, the NASA can blast off toward a sustained, scientifically sound exploration of outer space.

Vitally Needed Agency

The other outstanding aviation project before Congress is the creation of an independent Federal Aviation Agency with full authority to tackle the myriad problems of air traffic control and safety that have been so widely dispersed in a bureaucratic maze. This action, sparked by Senator Mike Monroney in the upper House and skillfully steered by Elwood "Pete" Quesada on the executive side of the government, is now facing its final hurdle in the House. We hope that Rep. Oren Harris, key man in the House for this bill, will provide some extraordinary bustle to match the performance of Senator Monroney and Mr. Quesada in assuring the creation of this vitally needed agency in the current session of Congress.

In defense, Congress has also compiled a better than average record with a Defense Department reorganization bill that at least takes a positive step toward untangling the Pentagon knot of indecision. As usual Congress also was more sensitive than the executive branch in providing adequate funds for development of key weapons in advanced missiles, aircraft and submarine programs. It has also begun to ring the bell on the vast bureaucratic expansion of the Military Air Transport Service into costly duplication of commercial airline services while neglecting the genuine problems of adequate military air logistics.

Congress also became more aware of the tremendously complex relationship between the military services and the industrial complex that develops and produces new weapons. It should study this problem more thoroughly in the future. This area needs a complete overhaul of both its legislative and administrative aspects to develop a modern streamlined military-industry relationship that protects the taxpaying public against excessive profits but at the same time permits industry to move with the speed its technical capabilities make possible.

—Robert Hotz

WHO'S WHERE

In the Front Office

Austin N. Stanton, board chairman, Varo Mfg. Co., Inc., Garland, Tex. **Robert L. Jordan** succeeds Mr. Stanton as president. Also: **George F. Lewis** and **Vice Adm. James H. Doyle** (USN, ret.), vice presidents.

Ralph S. Stillman, director, Fairchild Engine & Airplane Corp., Hagerstown, Md.

Felix A. Kalinski, a director, Vertol Aircraft Corp., Morton, Pa.

Lt. Gen. Roger M. Ramey (USAF, ret.), a corporate vice president, Northrop Aircraft Inc., Beverly Hills, Calif.

Raymond Fleury, president-director general, French rocket firm S.E.P.R., succeeding **Georges Glasser,** resigned.

Richard M. Johnson, president, Koehler Aircraft Products Co., subsidiary of New Britain Machine Co., Dayton, Ohio.

Nathan H. Wolf, president, Tube Methods, Inc., Bridgeport, Pa.

The Ramo-Wooldridge Corp., Los Angeles, Calif., has announced new responsibilities for the following: **Dr. Ralph P. Johnson,** group vice president-General Electronics Group of Divisions; **Dr. Burton F. Miller,** vice president and director-advanced systems planning; **Milton E. Mohr,** vice president-engineering; **Irwin A. Binder,** vice president-manufacturing for Denver and Los Angeles Divisions.

Honors and Elections

Dr. Jerome C. Hunsaker, Professor Emeritus of Massachusetts Institute of Technology, has been presented the Navy Distinguished Public Service Award, the highest award conferred on civilians by the Department of the Navy, in recognition of his outstanding contributions in the fields of scientific research and development.

George P. Sutton, manager of the Advance Design Section at Rocketdyne division of North American Aviation, Inc., has been named next year's Hunsaker Professor of Aeronautical Engineering at the Massachusetts Institute of Technology. Mr. Sutton, the first man from industry to be selected for the professorship, will conduct a course on rocket engine propulsion and also will do research on the design and development of rocket engines.

Changes

Stephen B. Elggren, sales manager, Niagara Frontier Division, Bell Aircraft Corp., Buffalo, N. Y.

Convair (San Diego, Calif.) division of General Dynamics Corp., has announced the following appointments: **A. P. Higgins,** assistant to the division manager-military relations; **J. H. Famme,** works manager-Plant Two; **W. W. Fox,** assistant chief engineer; **W. C. Keller,** to the general office military relations staff.

H. R. Oldfield, Jr., general manager of a new company component (not yet disclosed), Industrial Electronics Division, General Electric Co., Phoenix, Ariz. **C. C. Lasher** succeeds Mr. Oldfield as general manager of the Division's Computer Department.

INDUSTRY OBSERVER

► Nuclear rockets carrying personnel probably would be lifted to 50,000 or 60,000 ft. by solid propellant boosters before reactors were turned on in order to avoid shielding problems both on ground and in vehicle, according to Atomic Energy Commission thinking. At that altitude, there would be little scattering of radiation by the atmosphere, and shadow shielding can be used for crew compartment.

► **Convair-Fort Worth is proposing a low-weight nuclear auxiliary power supply to the Air Force for satellite and space vehicle application in connection with Project SNAP (Secondary Nuclear Auxiliary Power).**

► Pratt & Whitney J52 engine which powers North American's GAM-77 Hound Dog missile for the Boeing B-52G is carried in a pod suspended below the missile's fuselage. J52 does not carry afterburner. Pylon from which missile is hung contains monitoring and launching equipment.

► **Jetavator pitch and roll controls on Polaris fleet ballistic missile are buckets moved into the rocket exhaust to reduce the efficiency of one or more of the four nozzles (AW July 14, p. 22). Thrust differential created exerts the control moment. Variations in total thrust due to Jetavator action can be compensated by varying time to thrust termination.**

► Vernier engines used on the Atlas intercontinental ballistic missile for roll action and precision thrust adjustment are gimbaled as the main engines are. Propulsion system uses liquid oxygen and RP-1, a hydrocarbon similar to turbojet fuels which burns at temperatures above 5,000F.

► **Soviet air force ground crews are receiving intensive training in decontamination techniques aimed at getting fighters and bombers into the air at the earliest possible moment after nuclear bomb attacks on Russian airfields. Special machines and materials reportedly have been developed for quick decontamination of taxiing areas and runways. Flight crews wear bulky protective clothing while crossing radioactive areas of the airfield to reach their decontaminated aircraft.**

► Pre-cooling tests at Wright Air Development Center test chamber have shown that a person whose body temperature has been reduced by only two degrees can withstand temperatures of 160F for 40 min. longer than if he had entered the test chamber with normal body temperature.

► **Defense Department's Advanced Research Projects Agency already has programmed approximately 30 separate space projects involving a total of about $50 million.**

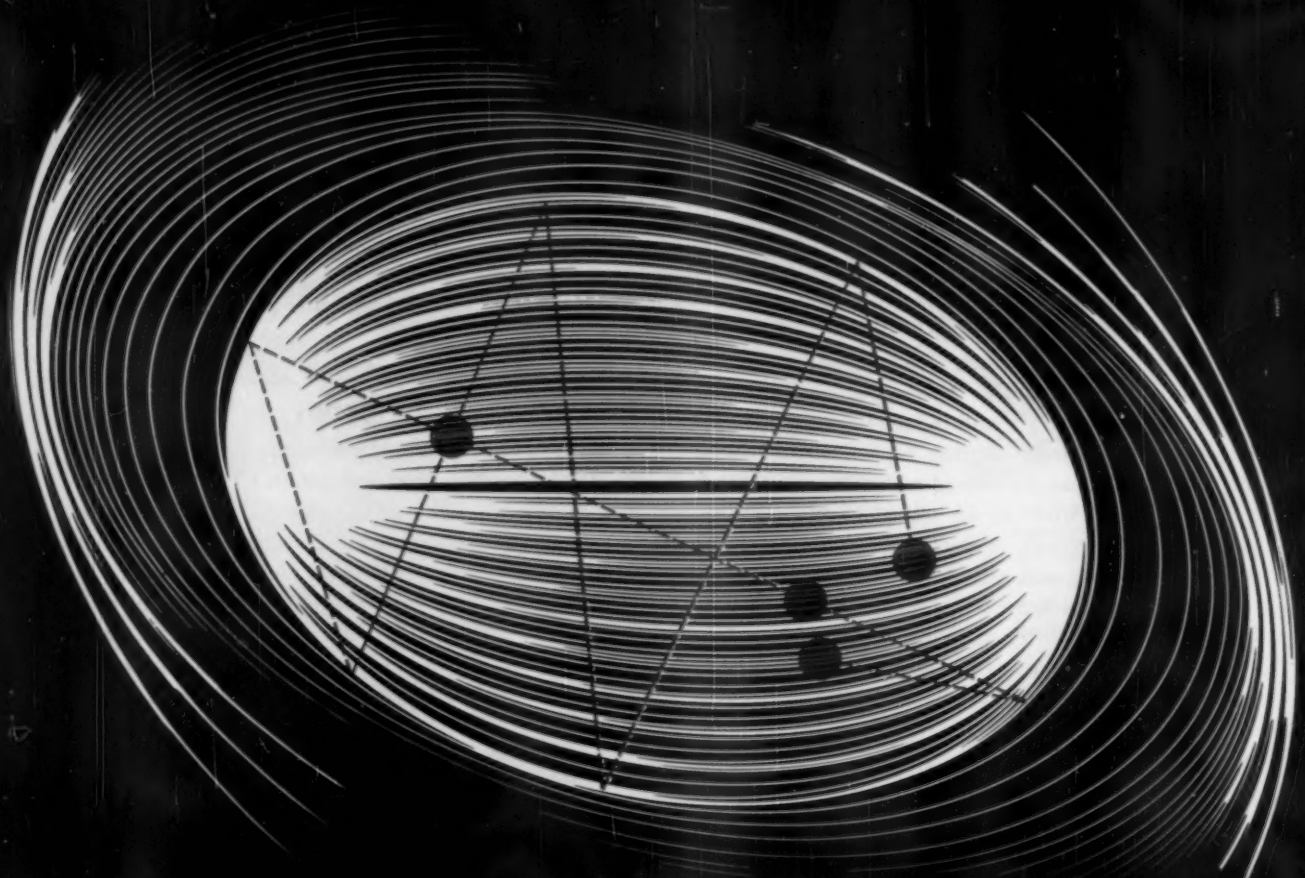
► George A. Fuller Co. has received an $11,762,420 contract for construction of six concrete launch pads and two concrete blockhouses for Atlas intercontinental ballistic missile site near Cheyenne, Wyo. Contract will be under jurisdiction of U.S. Corps of Engineers, Omaha.

► **Boeing B-52 to be used as the mother ship for North American's X-15 high-altitude rocket research aircraft is now undergoing modification at Boeing's Seattle plant. Previously, plane had been at the Palmdale, Calif., facility of North American Aviation.**

► Douglas Aircraft hopes to sell Air Force on a plan to use the DC-8 as a replacement for C-118A cargo aircraft as part of the over-all plan to modernize the logistics fleet.

► **Both Boeing and Douglas are working on cargo aircraft in the class of the now defunct Douglas C-132. Companies reportedly are working in both the pure jet and turboprop areas, with Douglas emphasizing the turboprop approach.**

► Increased climb performance and greater target altitude of Boeing's B-52G was achieved by redesign of wing to incorporate integral skin and stiffeners, reduction of vertical stabilizer to 40 ft., 8 in. and use of Pratt & Whitney J57-P-43W engines.



SAGE SETS AN ELECTRONIC "BEAR TRAP"

BURROUGHS ELECTRONIC DATA PROCESSING EQUIPMENT STANDS WATCH FOR OUR CONTINENTAL AIR DEFENSE.

Problems of the awesome speeds and scope that confront our military defense systems can only be solved by the quick and uncanny accuracies of electronic computation, such as is found in our Semi-Automatic Ground Environment—SAGE, which is now becoming operational! As a result Burroughs radar data processing equipment fills important posts all along our peripheral continental approaches.

This major U. S. Air Force contract is one example of the widespread confidence in Burroughs Corporation's 70-year background of reliability and capability. It demonstrates Burroughs' new breadth in the development of electronic equipment and its continuing competence from research to final installation.

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Washington Roundup

Space Interest Lag

Senate Appropriations Committee has criticized Air Force for "a growing lack of energy in space activities." The committee noted in its report that "while space is today for the scientists and those with imagination, it may be the battlefield of tomorrow and the Air Force cannot divorce itself from this vital field." The committee also objected that USAF has allowed contractors to build their own duplicate test stands at government expense while government facilities "idle or rust." The committee wrote a stipulation into the Fiscal 1959 defense budget banning the use of defense funds for construction or rental of private missile testing facilities "until the fullest use is made" of government sites.

Armed Forces 'Misutilization'

Rep. Albert W. Cretella (R.-Conn.) also wants a congressional inquiry into what he terms "misutilization of technical and scientific manpower in the armed forces."

Cretella in a floor speech said it has been estimated that the armed forces waste more than 15,000 men in their technical and scientific ranks. He added the men were either misassigned, completely misused or not used to the degree warranted by the formal scientific education and training they received as civilians. Added to this, he said, is the disproportionate amount of time the service technician may be required to devote to military duties, including kitchen police, guard duty, prisoner guard, housekeeping and cleaning details, while, he said, dozens of other groups manage to escape these details.

FCC Compromise Offer

Airline and industry petitions that Federal Communications Commission reconsider recent action to shift civil Doppler radars from 8,800 mc. to 13,000 mc. (AW June 30, p. 28) were turned down last week, but the commission made compromise moves. FCC says it "anticipates" issuing regular licenses, normally for five years, for 8,800 mc. civil Dopplers until the state of the art will permit a shift to higher frequency. Agency also says it will "endeavor, to greatest extent possible, to provide reasonable amortization period for 8,800 mc. Dopplers." First airline reaction to FCC statement was unfavorable, partially because of the many qualifications as to future possible action. FCC also set aside 13,250 to 13,400 mc. band currently assigned for government use, for both civil-government Doppler use.

Airport Aid Need

Civil Aeronautics Administration's reluctance to back an extension of the Federal Airport Act came under fire last week from the Airport Operators Council. Testifying before the Legal and Monetary Subcommittee of the House Government Operations Committee, Council Director E. Thomas Burnard said capital outlays required for airport improvements quickly outstrip revenues produced so that increased federal aid is the only means of attaining needed expansion. Burnard also told the subcommittee that airport facilities needed for jet transports should have been known at least three to five years ago. He advocated a system of more advanced planning between aircraft manufacturers, users and airport operators to prevent premature obsolescence of airport facilities. Lack of sufficient funds to meet future requirements, he said, "may well become the factor that limits the whole system."

Space Committees

Although resolutions establishing standing committees on aeronautics and space have been passed by both the House and Senate, chances are slim that members of either committee will be appointed during this session.

Least likely to take action is the House where all members are up for re-election. If the committee is appointed this session, there is always a chance some members would not return. The Senate could organize its committee this session but may elect to wait because of the heavy workload between now and adjournment and the work involved in selecting the members. Meanwhile, the current select space committees of both Houses can carry on for the remainder of the year.

Riddle Promise

Riddle Airlines President George L. Giles has promised the Civil Aeronautics Board to circulate a memorandum to his company's stockholders asking that they take no action on his earlier request that they communicate with their senators, representatives and members of the Board in Riddle's behalf.

In response to a letter from Board Chairman James Durfee protesting the original letter to the stockholders, Giles admitted that, "through my enthusiasm, I may have extended beyond the point of reasonable discretion" and apologized for any "inconvenience or embarrassment I may have inflicted on members of the Civil Aeronautics Board." Giles, who joined Riddle as president in February, was charged by the Board with attempts to influence its actions with a pressure campaign.

CAB Helicopter Ruling

Civil Aeronautics Board last week charged that commercial helicopter feeder services would be considered developmental in nature and would require more experimentation until a larger helicopter that is "economically feasible" is made available. The Board announced its decision in turning down a petition by Los Angeles Airways for a renewal of its temporary certificate on a permanent basis.

Unwanted Details

While airlines generally lauded Senate Appropriations Committee action in earmarking $84 million of the Military Air Transport Service budget for procurement of commercial air transportation, the scheduled carriers would prefer that detailed requirements were not spelled out.

Under the Defense Department appropriations bill as reported by the committee, $84 million was made available to MATS only for procurement of commercial air transportation. Of this amount, $21 million must be spent with U. S. carriers that qualify as small business enterprises. This includes most of the independent airlines. Purpose of the $21 million clause is to ensure a share of the business for the smaller carriers.

—Washington staff

HOW THE SILICONES MAN HELPED...

Build a Gyro for Straight Shooting!

Accuracy that could hit a fly from a screaming roller coaster . . . so rugged that it can be used to drive nails without impairing its operation. That's the "impossible" fire control gyro built by Minneapolis Honeywell, Aeronautical Division. Known as the HIG-5 (Hermetic Integrating Gyro), lightweight and small enough to hold in the palm of your hand, it supplies the "sense of balance" necessary at supersonic speeds.

Operating in a viscous fluid under wide limits of temperature and pressure, seals can be no less than perfect. What material was used? "O" rings of UNION CARBIDE Silicone Rubber.

Fabricated by Moxness Products Company, Racine, Wisconsin, these "O" rings were tested from −65 to +200 deg. F., at simulated pressures from ground level to operational altitudes. Under such rigid tests, UNION CARBIDE Silicone Rubber showed outstanding sealing qualities and resistance to compression set.

This is another example of how the UNION CARBIDE Silicones Man has helped solve an "impossible" problem. A booklet—"Look to UNION CARBIDE for Silicones"—describes silicone rubber and many other silicone products. Write Box HA 9702 today. Silicones Division, Union Carbide Corporation, 30 East 42nd Street, N. Y. 17, N. Y.

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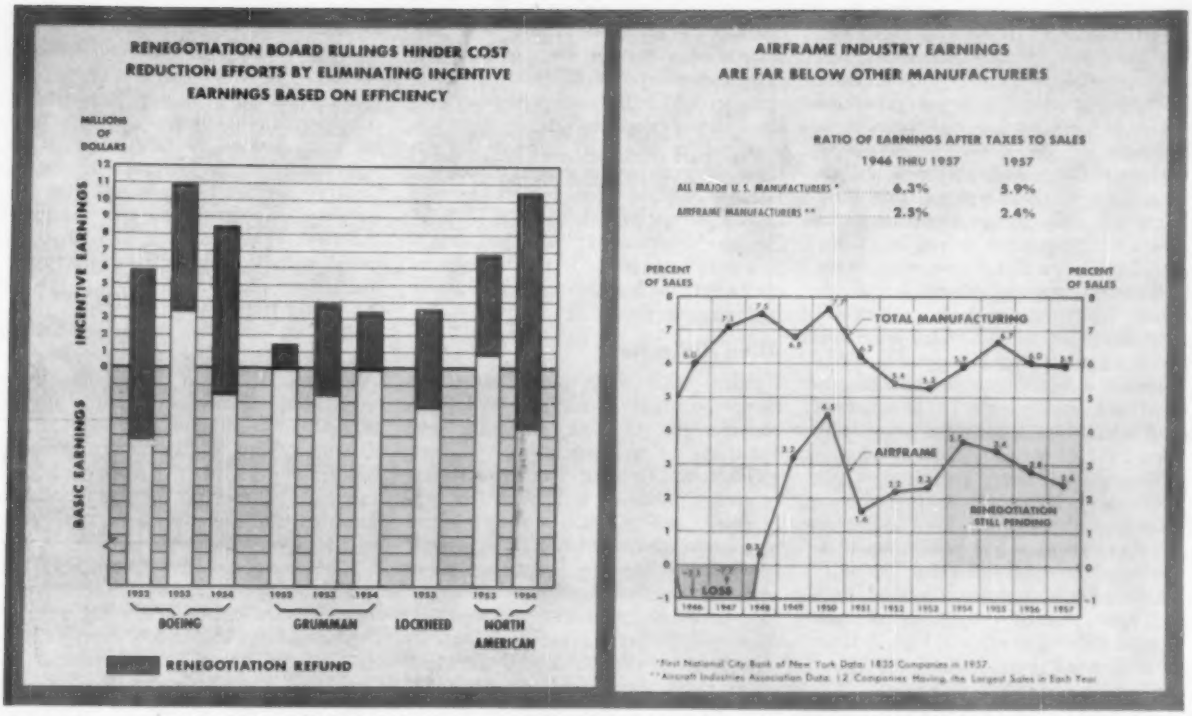


CHARTS were compiled by Aircraft Industries Assn. to support contention that Renegotiation Board action is hurting the industry.

Industry May Gain Renegotiation Change

By Katherine Johnsen

Washington—Outlook is that aircraft manufacturers will achieve a key change in the existing renegotiation law—the right to appeal contested cases from the U.S. Tax Court to the U.S. Court of Appeals. However, an extension of the act for at least one year beyond the present expiration date of Dec. 31 appears certain. Administration wants a two-year extension.

Department of Defense has joined Aircraft Industries Assn. in recommending this change. This was disclosed at House Ways and Means Committee hearings last week on the proposed extension. Defense Department's stand was outlined by its general counsel, Robert Dechert.

Cases Pending

Eight major aircraft companies now have cases pending before the Tax Court: Boeing Airplane Co., Douglas Aircraft Co., Fairchild Engine and Airplane Corp., Grumman Aircraft Engineering Corp., Lockheed Aircraft Corp., the Martin Co., Temco Aircraft Corp. and North American Aviation Inc., "And if present conditions continue, there will be additional cases," James H. Kindelberger, representing North American of which he is chairman of the board, told the committee. "We go out of our way to avoid litigation," Kindelberger said. "This deluge of cases in the tax court has resulted from very sober and sound judgment. . . . as a result of a feeling that we have not been accorded the consideration that justice demands."

Manufacturers are already in controversy with Justice Department over evidence to be considered by the court, he said. "Unlike every other case, the tax court will decide, without any further redress to us, matters involving millions of dollars."

The tax court decisions generally have been in favor of the Renegotiation Board.

The Administration is opposed to a second amendment proposed by AIA which stipulates that "incentive" profits earned by manufacturers be exempted from recapture through renegotiation "in order to encourage efficiency and cost reduction efforts."

Representing the Aircraft Industries Assn., Boeing President W. M. Allen testified:

"The Renegotiation Board seeks to reduce profits simply because they are profits. Thus, it is operating at direct cross-purposes to the efforts of the Department of Defense to reduce costs . . . The board removes the contractor's incentive to strive for the very cost reductions for which the procuring agency provided the incentive. Thus, the now-obsolete renegotiation act acts as a dead hand on the incentive to reduce costs."

Allen presented examples of four companies showing that renegotiation determinations have not only recaptured "incentive" earnings but have dug into the companies' basic profits as well. They were:

- **Boeing.** For 1952-54, the "incentive" earning was $25 million, the renegotiation refund $27.5 million.
- **Grumman.** The 1952-54 "incentive" earning was $8.7 million, the renegotiation refund $10.5 million.
- **Lockheed.** For 1953, the "incentive" earning was $3.7 million, the renegotiation refund $6 million.
- **North American.** For 1953-54, the "incentive" earning was $17.3 million, the renegotiation refund $20 million.

'Incalculable Losses'

One of the "incalculable losses" resulting from renegotiation, Allen declared, is that it confiscates earnings that would otherwise be ploughed back into private research and production facilities vital to technological advance.

"It creates an atmosphere in which the industry is reluctant to make long-term commitments for these essential expenditures," he said. "We cannot afford this self-imposed roadblock in our technological race with Russia. . . . The board's present policy of low earnings, by impeding progress and long-

Space Technology

First Lunar Shot to Seek Far Side Data

Air Force probe, first of USAF-Army series, now planned for Aug. 17; Russian May 1 attempt fails.

Washington—First of three lunar probes in Air Force's "Operation Mona," scheduled to be launched from Cape Canaveral, Fla., sometime between 6 A. M. and noon on Aug. 17, will attempt to achieve an orbit around the moon to transmit pictures of its yet-unseen far side and gather scientific environmental data in the moon's vicinity. AVIATION WEEK originally forecast this launch date as Aug. 16 (AW June 2, p. 15).

Air Force's plan to orbit the moon with its lunar probe is a bold and risky gesture in a three-cornered try for a successful "moon shot."

Effort of Russians to impact on the moon on May 1 failed, AVIATION WEEK has learned.

Army has its first moon impact shot scheduled for September.

While a moon impact would generate tremendous international propaganda value, Air Force is shooting for bigger odds by coupling scientific dividends with the propaganda value it would attain in placing a vehicle in orbit around the moon (AW June 16, p. 165).

Launch date was selected because of the advantageous relation of the projected orbit of the probe with the position of the moon. If launch problems develop so that the firing cannot be made on Aug. 17, lunar shot probably will be made on one of the following four days. Good light for surface picture scanning on the moon's far side will be available in this period for favorable definition of detail, particularly at the junction of light and dark areas.

Instrument package, including telemetering equipment will weigh approximately 30 lb. Transmitting frequency will be 108 mc. All information will be relayed to Air Research and Development Command's Ballistic Missile Division's Data Reduction Center in Inglewood, Calif.

According to present schedules, Air Force's second lunar probe will be launched in September, the third in October. These probes will be basically the same as the first probe but successively more sophisticated for gathering more advanced scientific data.

While the series of lunar probes, under cognizance of the Ballistic Missile Division, is known as Operation Mona, the vehicle itself is designated Thor-Able I. Moon-orbiting portion of the vehicle will carry still another distinctive designation.

Air Force already has obtained experience with basic two-stage Thor-Able configuration in recent nose cone and mouse experiments from Cape Canaveral (AW July 28, p. 27). Thor-Able I, an extension of Thor-Able's basic configuration, will consist of the following stages:

- **First stage**—Douglas Thor intermediate range ballistic missile.
- **Second stage**—Aerojet-General's liquid propellant rocket for Vanguard II, modified for Thor-Able I requirements.
- **Third stage—Allegheny Ballistics** Laboratory's solid propellant rocket engine, which the Ballistic Missile Division has selected instead of an alternate choice of Grand Central Rocket Co.'s solid propellant unit as used for the Vanguard third stage. Ignition and burning characteristics of Able's solid propellant unit were checked out at Arnold Engineering Development Center's Tullahoma, Tenn., facility, proved satisfactory.
- **Terminal stage**—used for additional thrust in the general vicinity of moon.

After launching, first three stages of Thor Able I will burn out relatively quickly and separate from probe, which will continue to coast for remainder of trajectory until it approaches and begins to parallel lunar orbit, when the moon will be approximately abreast of the probe.

Speed of the probe then would be about 400 to 500 fps. as compared with approximately 3,350 fps. for the moon in its orbit. Elapsed time from launch to moon vicinity will be about 2.6 days. To prevent the moon from "running away" from the probe and to allow the moon's gravitational field to pull the probe into a relatively close satellite orbit around the forward portion of the moon, the probe's speed will be boosted by cutting in the terminal rocket by command signal. Terminal rocket will stay with the probe as it orbits around the moon.

Another scheme which had been considered for the lunar probe was to circumnavigate the moon and, after the single turn, to have the vehicle return to the earth's atmosphere. This would not require terminal thrust but would give less time for observations in the lunar area than that attainable with a probe as a satellite of the moon.

Widely scattered stations will track the probe. These will be located at:

- **USAF Missile Test Center, Fla.**
- **Lincoln Laboratories, Mass.**
- **Manchester, England,** site of world's largest radio telescope owned by the University of Manchester.
- **Singapore.**
- **Hawaii.**

Army probe, scheduled to be fired in September under jurisdiction of Army's Ballistic Missile Agency, Huntsville, Ala., is known as Juno II. It will use the Jupiter IRBM as its first stage, a cluster of 11 scaled solid-propellant Sergeant rockets for the second stage, which will, in turn, surround a cluster of three Sergeants as the third stage, which will surround a single Sergeant as the final stage. This probe also will be fitted with a camera installation which probably will afford less definition than that available from scanner in Air Force's Thor-Able I lunar probe.

Over-all supervision of both USAF and Army lunar probes lies with Defense Department's ARPA.

Feeling in some scientific circles is that the moon shot should be bypassed, allowing the Russians to attain this objective first, and that all U. S. effort should be directed to attain successful trajectories to Venus and Mars.

Minuteman Contractor

Washington—Invitations to potential contractors for assembly and test of Air Force's Minuteman multi-purpose ballistic missile have been sent out by Air Research and Development Command's Ballistic Missile Division.

The contractor would be the equivalent of the over-all manager of the Minuteman project. Invitations to attend a pre-proposal briefing at BMD headquarters in Inglewood, Calif., on Aug. 5 and for an orientation briefing on Aug. 12 at the USAF Missile Test Center, Cape Canaveral, Fla., to acquaint contractors with test facilities there since the test phase presumably would be conducted at that site.

Proposals by industry segments who will be briefed on Minuteman's assembly and test phase will have to be submitted to Ballistic Missile Division by Sept. 8.

Total of 19 companies have been invited to briefings on assembly and test phase for Minuteman and to submit proposals for the AT contract. Companies include Boeing, Ryan, Northrop, Radioplane, Aeronutronic Systems Inc., Douglas, Chrysler, Studebaker-Packard, Curtiss Wright.

NACA Space Proposals

Washington—One of the first functions of the new National Aeronautics and Space Council will be to propose a step-by-step space program to President Eisenhower for approval. An outline of a suggested program was prepared by the National Advisory Committee for Aeronautics and submitted to the House Space Committee by Dr. Hugh L. Dryden, NACA director. It proposes:

I. Unmanned space flights to acquire scientific data, including:

- **Vertical probes.**
- **Satellite to study space environment.**
- **Lunar probes.**
- **Planetary and interplanetary probes.**
- **Weather reconnaissance.**
- **Communications developments.**
- **Astronomical observations.**

II. Investigations of manned space flight, including:

- **Small-scale recoverable orbiter.**
- **Vertical flight and re-entry vehicles.**
- **Manned orbital and re-entry vehicles.**
- **Supporting biological studies.**

III. Research and development on advanced components and techniques, including:

- **Propulsion systems—development of special rocket motors using conventional propellants and high-energy rocket motors plus initial contract development of million-pound thrust rocket motor.**
- **Vehicular subsystems—auxiliary power supplies, controls, communications, displays, personnel equipment, guidance systems and computers.**
- **Instrumentation—vehicle-borne scientific instruments, tracking systems, telemetering systems.**
- **Vehicles—stabilized satellite space platform, propulsion and subsystems test vehicles.**

IV. Research facility requirements, including:

- **Adaption of pilotless aircraft research station for handling large liquid-fuel rocket motors.**
- **Extension of instrumentation facilities.**
- **High-energy rocket research facilities.**
- **Guidance and control facilities.**

fix responsibilities for direction of all activities and advise the President on the development of an over-all space program.

The most urgent requirement from the standpoint of time and expediency is the selection and approval of an administrator of NASA. Until he has been appointed and confirmed, organization and operation of the space agency will be at a standstill.

Most often mentioned for the post is Dr. Hugh L. Dryden, director of the National Advisory Committee for Aeronautics which will form a nucleus of NASA.

Currently, a large part of NACA's resources already are being used for space research and technology.

Groundwork Begun

Much of the groundwork necessary to form the new agency and preliminary preparations for launching the civilian space program have been completed by Dryden at the direction of the President.

The presidential directive called on NACA to:

- **Formulate detailed plans to reorient** its present programs, internal organizations and management structure to carry out the functions of NASA, including the functions now performed by NACA. Plan and propose such additional actions and programs as may be necessary to implement the legislation, including requirements for additional staff, facilities or funds that may be needed by NASA in the immediate future.
- **Jointly review** with Defense Department pertinent programs currently under way or planned by the Department and recommend which of these should be placed under the new agency, either by cooperative arrangement or by transfer, and plan to coordinate supporting research and development to provide for the needs of both military and civilian programs without unnecessary duplication.
- **Discuss with the National Science** Foundation, National Academy of Sciences and other government agencies or civilian groups the matter of participation of the scientific community on a continuing basis in planning and coordinating the scientific programs for use of space vehicles in civil science.

One of the most important questions facing the new agency is how much money will be appropriated for its operations during Fiscal 1959 and how quickly congressional action can be completed on its requests.

In the report published by the House Committee on Astronautics and Space Exploration, it was suggested that about $500 million a year would be needed for the first two or three years. The President, however, asked Congress for $125 million in new funds for non-military space projects. In addition, $117 million will be transferred from the Advanced Research Projects Agency. The latter funds were appropriated for civilian projects now under the direction of that agency.

Approximately $101 million more requested for NACA will be transferred to NASA to carry out the present NACA program.

This will give the new space agency about $343 million for the current fiscal year.

Satellites Suggested For Blast Detection

Geneva—Earth satellites properly instrumented have been suggested by East-West conference of scientific experts meeting here as one of three techniques applicable to detection of high altitude bursts of nuclear weapons.

Others are radio detection, presumably by radio telescope, and detection by light sensitive means of intense flash from such bursts.

Problem of detection of high altitude bursts is one of two regarded as extremely difficult; other is subterranean explosions. Gaining some momentum is a proposal to fire a series of upper altitude bursts under international control for development of detection techniques, but seasoned observers agree this scientific scheme will get lost in a political forest.

Four systems have been recommended through mutual agreement between Western and Soviet bloc scientists in their month long meeting here: sound, earth shock, radio waves and radioactive product collection. Contention came from detailed discussion of the fourth system with Western scientists arguing for monitoring aircraft necessary for collection and Russians maintaining that measuring debris at ground stations is adequate. Russians also say no planes will be permitted to fly over the Soviet Union on collection missions until international tensions lessen.

However, the Western group believes adequate information could be obtained by flying over international waters and are not too disturbed by the Russian refusal.

range economies, is leading inexorably to poorer and more costly defense."

Renegotiation Board and Defense Department strongly urged continuation of renegotiation at the House hearings:

• **Thomas Coggeshall,** the board's chairman, declared that "renegotiation functions not only to recapture excessive profits but to prevent them. It is common knowledge that the mere existence of the renegotiation authority frequently induces contractors to price more closely than they otherwise would, and thus avoid accruing excessive profits. The resultant dollar savings to the government are incalculable." He reported total recoveries through renegotiation since 1951 of over $1.5 billion, or over $539 million after estimated taxes. Petitions for tax court review have been made for only 2.2% of the 3,202 determinations of excessive profits made by the board, he said.

• **Robert Dechert, defense counsel,** testified that present conditions of new weapon developments and high defense expenditures "re-emphasize" the necessity for renegotiation. He said:

"While Defense Department has provided its contracting personnel with considerable means of dealing with cost uncertainties, even in cases of new and experimental products, there remain areas in which only renegotiation can be fully effective to assure that the government gets what it needs for defense without paying excessive profits." Because of rapid technological advances in the aircraft missile and space field, Dechert commented, "past production and cost experience is not necessarily satisfactory for forecasting and for avoiding excessive profits."

Allen Objections

Allen made these major objections to renegotiation in addition to its discouragement of cost reduction and technological progress:

• **Obsolete.** Defense Department has evolved a flexible and objective procurement system which assures fair and reasonable prices to the government in the vast majority of cases where actual earnings realized are in the aggregate in excess of those contemplated. Allen noted that renegotiation was designed for a World War II situation when there were quick procurements with inadequate machinery.

• **Broadsword used against the** airframe industry as a whole. "The Board has said, in effect, that airframe industry earnings, as a whole, are excessive," Allen protested. "It would be understandable if one company, in a particular year, had its earnings reduced to something like the U. S. manufacturing industry average." He noted that the earnings of airframe manufacturers for the 1946-57 period were 5.2% as compared with the over-all manufacturing average of 13.1%.

• **Criteria too vague.** The seven yardsticks laid down in the renegotiation act for determining excessive profits, Allen said, "are so vague that their application of necessity results in no more than the individual judgment of five men, who, unlike the contracting officers who negotiate defense contracts, can have little or no detailed first-hand knowledge of the work performed years ago."

The renegotiation act yardsticks are "efficiency of contractor," "reasonableness of costs and profits," "net worth," "extent of risk assumed," "contribution to the defense effort," "character of business," and "other factors considered important by the Renegotiation Board."

Space Technology

NASA Organization Awaits New Action

By Ford Eastman

Washington – Presidential approval of legislation establishing a new National Aeronautics and Space Administration is only the beginning of the action required before the agency can move into full-scale space exploration.

The President's signature on the National Space Act approved by Congress (AW July 21, p. 18) creates the administration in name only. The speed with which it can be organized and its ability to meet or surpass Soviet advances in space technology depend upon subsequent moves in both the White House and Congress.

In signing the bill, President Eisenhower commended Congress for its promptness in creating the organization and termed enactment of the legislation a "historic step" in equipping the United States for leadership in the space age.

He also praised the National Advisory Committee for Aeronautics, which will form the nucleus of the new agency, for its long established record of research and cooperation with the military services.

He said the combination of space exploration responsibilities with the NACA's traditional aeronautical research functions is a natural evolution.

With the act now signed, these steps either must be or are being taken before the agency can move forward effectively:

• **President must name his choice** for administrator and a deputy administrator and transmit it to the Senate for approval.

• **President must submit to Congress** a proposed budget for NASA and request authority for construction of facilities and purchase of equipment necessary to begin the initial steps of space exploration. If Congress fails to appropriate sufficient funds during the few weeks remaining in the current session, the agency's progress could be seriously curtailed for the next six months or year.

• **President must appoint** one government member and three civilian members of the Aeronautics and Space Council and submit the names to the Senate for confirmation. He also must submit to the Senate for confirmation the names of alternate members designated by each government member to sit on the council in the event of his unavoidable absence.

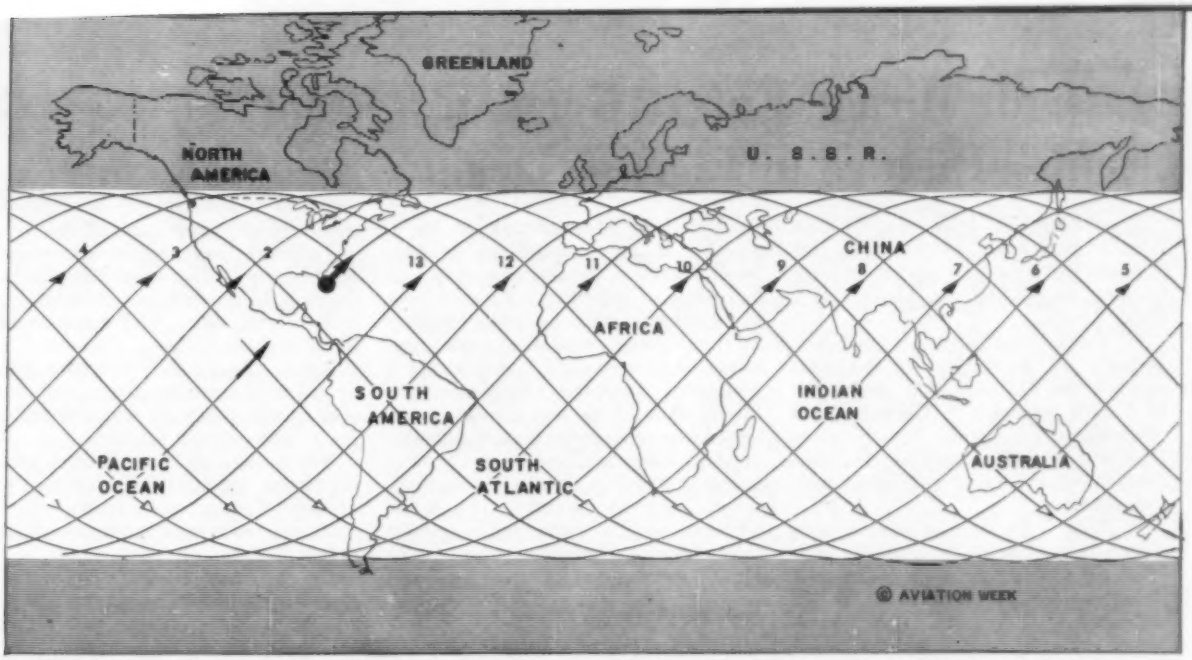
• **President must appoint a chairman** of a Civilian-Military Liaison Committee created under the act to increase coordination and cooperation between the administration and the military.

• **After appointments** have been confirmed by the Senate, the NASA administrator must announce by proclamation published in the Federal Register that the administration has been organized and is prepared to discharge the duties and exercise the powers conferred upon it.

• **Along with organization of NASA,** all facilities, personnel and activities of the National Advisory Committee for Aeronautics must be transferred to the new agency.

• **President must transfer facilities,** personnel and activities of other federal agencies, including those in the Defense Department, which are concerned primarily with the exploratory and peaceful aspects of space and are necessary for the immediate operation of NASA. The President must submit a full report on the nature and effect of all transfers made before Jan. 1 to both the House and Senate. After Jan. 1, no transfer can be made without Congress first receiving a report and having an opportunity to protest.

• **Space Council must meet** to survey the significant aeronautical and space activities of all agencies, develop a program for the agencies, designate and



EXPLORER IV makes 13 passes in a 24-hr. period. Because satellite vehicle was launched into an orbit inclined at 50.82 deg. north of the equator, orbital band extends 51 deg. north and 51 deg. south. Satellite orbits over the densely-populated northern latitudes.

Reports Corpuscular Radiation Intensity

created when solar electrons bombarded the satellites' skins.

Although intensity and energy of the particles vary greatly, the radiation may increase with distance from the earth and may extend all the way to the sun. Count at about 1,000 mi. out is 35,000 particles per second.

Explorer IV's special equipment for investigating this radiation is:

• **Geiger counter with a dynamic range** that allows it to detect and scale at 1,500 times the capacity of counters in earlier Explorers.

• **Shielded Geiger counter.** Covered with ¼th of an inch of lead, this will measure absorption of X-radiation and count intensities of higher energy cosmic rays and may help determine the amount of shielding needed to protect passengers in spacecraft.

• **Two scintillation counters** to measure total amount of energy flow from the radiation. Detectors are crystals of cesium iodide glued to the face of photo-multipliers.

Explorer IV carries a 10 milliwatt transmitter using 108 mc for the Army's Microlock radio monitoring network, and a 30 milliwatt transmitter using 108.03 mc, the Minitrack frequency. Previous Minitrack transmitters in Explorers have used 60 milliwatt power. This was reduced in IV to gain a longer broadcast time. Mercury batteries power both transmitters and expected life for both is two months.

Total instrument weight is 18.26 lb. compared to 10.63 for the first Explorer and 10.83 for Explorer III. Instrument package was developed by graduate students George H. Ludwig and Carl E. McIlwain of the Physics Department of the State University of Iowa, under the direction of Dr. James A. Van Allen, head of internal instrumentation work for the U. S. International Geophysical Year Committee's Technical Panel for the Earth Satellite Program.

Dr. Van Allen first reported the newly discovered radiation last May 1, following the Mar. 26 launching of Explorer III.

Data obtained from Explorer IV probably will be reduced more quickly than with earlier satellites, since temperature and micrometeorite data does not have to be separated out. Results will be supplied to all countries participating in the IGY, including the Soviet Union.

Explorer IV gains the benefit of a greater number of radio and optical tracking stations than any earlier U. S. satellite. Since last July 5, all 12 Baker-Nunn telescopes in the optical tracking network established by the Smithsonian Astrophysical Observatory have been in action. Microlock stations in the U. S. now number 10. They are located at Cape Canaveral, Fla.; Ft. Monmouth, N. J.; Redstone Arsenal, Ala.; Van Buren, Me.; Aberdeen Proving Ground, Md.; White Sands, N. M.; Cedar Rapids, Iowa, and Temple City, China Lake and Goldstone Test Station, Calif. They report to an evaluation center at Army Ballistic Missile Agency.

ABMA again handled assembly and launching of Explorer. The modified Jupiter-C used as a launching vehicle consisted of a modified Chrysler Redstone missile as a first stage; 11 scaled-down Sergeant solid rockets as the second stage; three solid rockets as a third stage, and a single solid rocket for the fourth stage, which is a part of the orbiting vehicle itself.

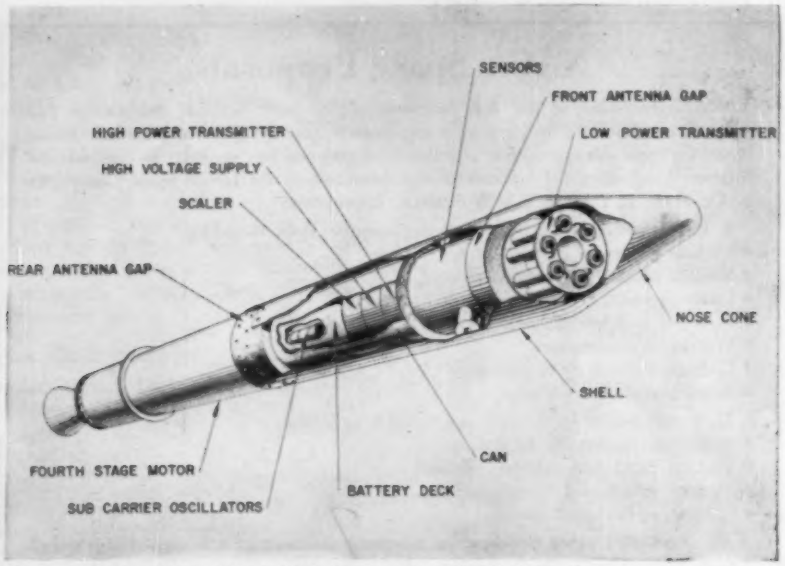
Only third and fourth stages contained the new propellant developed by JPL, details of which Army and JPL declined to discuss.

External Configuration

Externally, the orbiting vehicle is exactly like the third Explorer—bullet-shaped, 80 in. long and 6 in. in diameter, consisting of a 46-in. motor that weighs 12.67 lb. after burnout, and the 25.76 lb. satellite. Explorer IV uses two dipole antennas which are part of the satellite skin, as did Explorer III. Explorer I's turnstile antenna with four whip elements was blamed for perturbations which apparently causes the satellite to fly pinwheel-fashion through space.

Earlier satellites still in orbit are Explorer I, launched last Jan. 31; Vanguard I, a 6.4 in. test sphere launched last Mar. 17, and Russia's Sputnik III, launched last May 15. Sputniks I and II and Explorer III have disintegrated, and Explorer II did not go into orbit.

ARMY Jupiter-C that put Explorer IV in orbit is launched from Cape Canaveral.



ARMY'S Explorer IV satellite is 80 in. long and weighs 38.43 lb. Instrument package contains four separate radiation detectors. Satellite was launched by Jupiter-C (left).

Space Technology

Army Explorer IV Satellite

By Evert Clark

Washington—Army's Explorer IV, the first earth satellite designed specifically to investigate a problem discovered by earlier satellites, was reporting successfully last week on the energy and intensity of corpuscular radiation that must be considered in planning manned space flights.

Explorer IV was the first space vehicle launched and the first project completed under supervision of Defense Department's four-month-old Advanced Research Projects Agency.

It also is the first U.S. satellite to cover all of this country and to pass over Soviet territory. Fired into an orbit inclined at 50.82 degrees north of the equator at 11:06 A.M., E.D.T., July 26, it passed over a point north of the city of Stalingrad approximately six and a half hours later. Its orbit also takes it over Russian missile launching sites north of the Caspian Sea.

The Satellite sweeps a band 7,000 mi. wide around the earth, between 51 deg. north latitude and 51 deg. south latitude, compared to a band 4,700 mi. wide for earlier U.S. satellites. The angle of inclination was a compromise between the desire to check radiation at the most extreme latitudes possible—since intensity is believed to be greatest nearest the poles—and safety considerations at the Air Force Missile Test Center's range.

This angle probably is the greatest at which any satellite can be fired safely from Cape Canaveral, Fla., without the risk of booster stages impacting on land. Explorer I was launched at 33.5 deg., Explorer III at 33.37, and Vanguard I at 34.25 deg.—all inclined south of the equator. Polar orbits must await firings along the Pacific Missile Range in California.

New Solid Propellant

A new solid propellant developed by Army's Jet Propulsion Laboratory at California Institute of Technology was used in the third and fourth stages of the launching vehicle to compensate for the 7.43 lb. weight gain of Explorer IV over Explorer III.

Initial apogee of this satellite was reported by Naval Research Laboratory as 1,373.3 mi.; initial perigee was 162.9 mi., and initial orbital period was 110.2 min. Four days after launching, apogee was reported as 1,379.8 mi.; perigee as 157.3 mi., and orbital period as 110.224 min. Speed at apogee was 14,232 mph.; at perigee, 18,406.

This apogee takes Explorer IV well into the radiation discovered by Explorers I and III, which begins about 600 mi. above the earth. Until this launching, only circumstantial evidence supported the theory that the radiation existed.

Geiger counters in the earlier Explorers were jammed, apparently by extremely intense, high energy radiation that was believed to be X-radiation

Aircraft Industry Earnings Down; Orders Indicate Early Upturn

New York—Enough first half reports are in for major aircraft companies to show that the income picture is not bleak, though sales and earnings generally are down.

Latest reports showed these trends:

• **Bell and Chance Vought** showed increases in earnings.

• **The Martin Co.** reported sales and earnings down.

Previously, Douglas Aircraft Co. and North American Aviation reported declines in sales and earnings (AW July 21, p. 19).

• **Cessna Aircraft Co.** reported sales and earnings increases.

• **Beech Aircraft Co.** showed declines. Earlier, Piper had also reported a drop in sales and earnings.

Earnings of Chance Vought Aircraft were more than twice those of a year ago—$4,748,226 compared with $2,125,989. Per share earnings were $4.35 for the 1958 first half compared with $1.95 for the previous year's period.

Sales totaled $153,838,946 compared with $86,044,763 last year. The company reported it was negotiating for substantial orders for its present products and for new products to be purchased from Fiscal 1959 funds.

Bell Aircraft Corp. said its major improvement was in the second quarter. Per share earnings rose from 29 cents the first quarter to 52 cents in the second. Thus the company was able to overcome a slow first quarter to show total earnings for the first half of $2,175,703 co: .pared with $2,121,645 for the same period last year, or 81 cents per share compared with 79 cents.

First half sales declined slightly, to $100,757,151 this year from $103,349,885.

Leston Faneuf, Bell president, said the upward trend would level off in the third quarter. But earnings for the second half, he said, would at least equal those of the first.

Pinch on aircraft profits was typified in the Martin report. Three year trend for the company shows first half sales in 1956 of $138,960,590 increasing to $209,381,243 last year then falling to $188,225,985. At the same time, net income declined each year, from $4,442,232 in 1956, to $4,425,932 in 1957 and $3,590,271 this year. Sales this year, though down, still were higher than 1956. Per share earnings were $1.57 in 1956, adjusted for a stock dividend. They declined to $1.51 last year and $1.23 this year.

Sales gain of 31% for the first nine months of the current fiscal year compared with the previous similar period are reported by Cessna Aircraft Co., while Beech Aircraft noted a slight decline in the same period.

Cessna sales for the nine months just concluded totaled $66,660,000, with third quarter sales totaling $22,232,000, a gain of 19% over the same quarter last year. Company declared a regular quarterly dividend of 40 cents payable Aug. 12. Cessna President Dwane L. Wallace reports that he expects sales in Fiscal 1958 to exceed $80 million, which would be some $10 million higher than Fiscal 1957, with earnings per share coming close to $6 per share compared with $5.04 last year.

Beech income for the first nine months of Fiscal 1958 totaled $74,665,376 compared with $75,960,651. Net sales totaled $74,127,779 compared with $75,690,095 in Fiscal 1957. Net income after taxes in nine months just ended was $2,447,894 compared with $2,478,019 in 1957. As of June 30, Beech commercial and military backlogs totaled $73,365,367.

Other Developments

Other developments include:

• **Solar Aircraft Co.** reported substantial financial improvement in its 1957-58 annual report. The company had shown losses in parts of the previous year. Net income for the latest year rose from $384,981 to $1,555,466 on sales of $78,706,060. Bank loans were cut from $15,500,000 at the end of the previous year to $5,000,000. Cash remained at a level of $3,300,000 and although total current assets fell, the ratio of current assets to current liabilities rose from 1.4 to 1 to 1.9 to 1.

• **National Aviation Corp.**, an investment company specializing in aviation securities, added Lockheed Aircraft Corp., Hewlett-Packard Co. and Varian Associates to its portfolio, eliminated Bendix Aviation Corp. during the first six months of this year. It increased holdings in seven of the 11 airlines carried in the portfolio.

• **Fairchild Camera and Instrument** Corp. Six-month net sales slumped to $15,388,000 from last year's $19,956,000. First quarter loss was $209,000, which company said was caused through financial provision for formation of new Fairchild Semiconductor Corp. and integration cost of Teletypesetter acquisition.

• **Varian Associates** first quarter sales were $5,054,784, a hike of 11% over a similar period last year. Company said net earnings are up 46% from $234,210 last year to $341,952 this year.

• **Packard-Bell Electronics Corp.** sales totalled $26,401,343 for a nine month period ending June 30, a 12% increase over last year's $23,503,944. Net profits were $633,948, compared with $463,120 a year ago.

• **Rheem Manufacturing Co.** reported a net loss of $472,350 for the six months ending June 30. Last year, company net earnings were $1,473,307 for the same period. First half sales were $73,533,054, a drop of $27,701,655 under last year.

• **Rockwell-Standard Corp.**, Coraopolis, Pa., said the company's net profit in the last six months was $3,731,118, against $8,585,165 for a like period last year. Net sales this year totaled $45,737,167, a drop of $24,274,499 under the first six months of 1957.

Rockwell-Standard earnings include those of Aero Design & Engineering Co., manufacturer of Aero Commander aircraft series.

Republic Enters Astronautics Field

Farmingdale, N. Y.—Republic Aviation Corp. last week said it is entering the astronautics field and will spend $35 million for research and development for its transition into the missiles and spacecraft business.

Four-year program will include construction of a $14 million Engineering and Research Development Center at Farmingdale. Mundy I. Peale, Republic president, said the program also calls for major expansion of the company's technical personnel through addition of scientists and engineers to the staff.

Republic's new research and development laboratories will include:

• **Space Environmental** laboratory which will simulate altitudes of space flight.

• **Re-entry Simulation and Aerodynamic** laboratory to support studies at orbiting speeds and temperatures encountered at re-entry.

• **Materials Development** laboratory for study of properties necessary for high speeds and associated environments.

• **Electronic Laboratory** which will concentrate on missile and space avionics and new techniques in guidance.

• **Guidance and Control System** laboratory to work with infrared, optics, inertial components and servomechanisms to develop power systems for missiles and spacecraft.

• **Advanced Fluid Systems** laboratory for experiments in high pressure, high temperature hydraulic systems and liquid, gas and hot gas systems for use in rockets and missiles.

Other astronautical projects which will be studied are space platforms, in-

Rehearsal for Mach 3 at 100,000 feet

Dassault Mirage Enters German Fighter Picture in License Deal

Bonn—Friedrich Flick, one of Germany's wealthiest industrialists, reportedly has signed an agreement with Dassault to produce the Mirage III-A under license.

Flick's personal assistant denied categorically all connection between his superior and Dassault, and production of French airplanes in Germany. But observers cited similar denials when Flick was acquiring control of Daimler-Benz, German engine and automobile manufacturer.

In Paris, a Dassault spokesman confirmed association of his company with Flick, saying the agreement is "at least one year old." A source close to top management at Siebel ATG, of Donauworth, admitted such a deal was being discussed some time ago, but did not know whether final agreement had been reached. Flick has a majority interest in Siebel.

Top technician at Messerschmitt said he knew nothing about the deal but emphasized that if such an agreement were concluded, Messerschmitt would certainly be chosen to participate. Flick's most recent acquisition was large share of Dynamit AG, explosives and plastics producer.

Price Details

Final agreement is said to have been reached in mid-March. Shortly thereafter, Flick is understood to have submitted a voluminous and detailed memorandum to the Defense Ministry outlining manufacturing and price details.

Price of the airplane, for an order of 200-300 would be between $600,000 and $675,000 apiece. Dassault would start training German engineers and technicians in 1959 and would initially supply some sub-assemblies. First three pre-production models would be turned over by Flick to German Research Center team in March, 1960.

Initial production would be at the rate of nine per month, rising to 13, then to 15.

It would taper down to five per month with completion of the order in September or October of 1963.

It is believed that Dassault would receive 15% of the sales price for its licensing. French firm's decision to tie up with Flick rather than Flugzeug Union Sued, consisting primarily of Messerschmitt and Heinkel, is understood to be based primarily on economic factors.

Dassault has been weathering some heavy financial storms and neither Heinkel nor Messrschmitt is in a position to raise capital on its own hook. Flick, on the other hand, is said to be one of the three wealthiest men in Germany and has extensive holdings in iron, steel, automotive works, cellulose, machine-building and cement. A leading munitions manufacturer in World War II, he was convicted and served part of a sentence as an exploiter of slave labor and looter of German-occupied countries. During 1950, Flick rebuilt his financial empire to a point where it now is estimated as greater than Alfred Krupp's, long the symbol for industrial power.

Subcontracting Forseen

German Defense Ministry probably would insist that some components for the Mirage be farmed out to Flugzeug Union Sued. This southern group, which also includes Boelkow and Junkers, has tied its fortunes more closely to the American firms in the expectation of a decision in favor of Lockheed or Grumman's F-11F-1F Super Tiger.

Siebel ATG would neither confirm nor deny that it would be major contractor for the Mirage III-A should the Defense Ministry select the French fighter.

A Defense Ministry spokesman would only say that no decision between the Lockheed F-104A and the Mirage III-A has been reached. Defense Minister Franz Josef Strauss, in his last statement on the subject, said a decision would be taken in October (AW July 14, p. 37). Date for an order has been successfully postponed over the past year.

However, German sources say that technical experts in the Ministry are now sold on the Mirage III-A.

Earlier this year, following a tour of the U. S. by Lt. Gen. Josef Kammhuber, German Air Force Chief, a decision in favor of the Starfighter had virtually been reached.

Applecart reportedly was then upset by top-level German government decision to adopt NATO recommendation for a multi-purpose fighter.

The F-104 had been selected primarily for an interceptor mission, despite a public German proclamation that a multi-mission type of airplane was being sought.

On the basis of multi-purpose roles, Defense Ministry technicians reportedly are pushing for the Mirage over the Starfighter for the following specific reasons:

- **Mirage III-A can be launched** with zero-start from a standard Matador missile ramp. Present F-104 would require pilot to withstand 7.4Gs against acceptable 4Gs for Mirage.
- **Mirage can take off** from unimproved grass runway; Starfighter cannot. With 50 ft. obstacle, on concrete runway, Mirage required about 2,800 ft. for takeoff. Starfighter required approximately 6,000 ft.
- **Mirage can be utilized** in ground-support mission much more easily than Starfighter. Both can be adapted for trainer and reconnaissance missions.

Ground Costs

Flick also claims that servicing would be cheaper for the Mirage than for the Starfighter and spare parts would cost approximately half the American counterpart.

The Sneema Atar 9 jet powerplant for the Mirage III-A would initially be manufactured in France. However, license production is also foreseen in Germany either through BMW or Daimler-Benz in which Flick has a 38% interest.

There has been talk of a deal between BMW and Daimler-Benz.

Armament for the Mirage III-A would consist of two to four French-AA22 missiles.

Fighter-bomber version would differ from interceptor by dropping off rocket booster.

Flick is understood to be currently negotiating with Defense Ministry about servicing, spare parts and subcontracting.

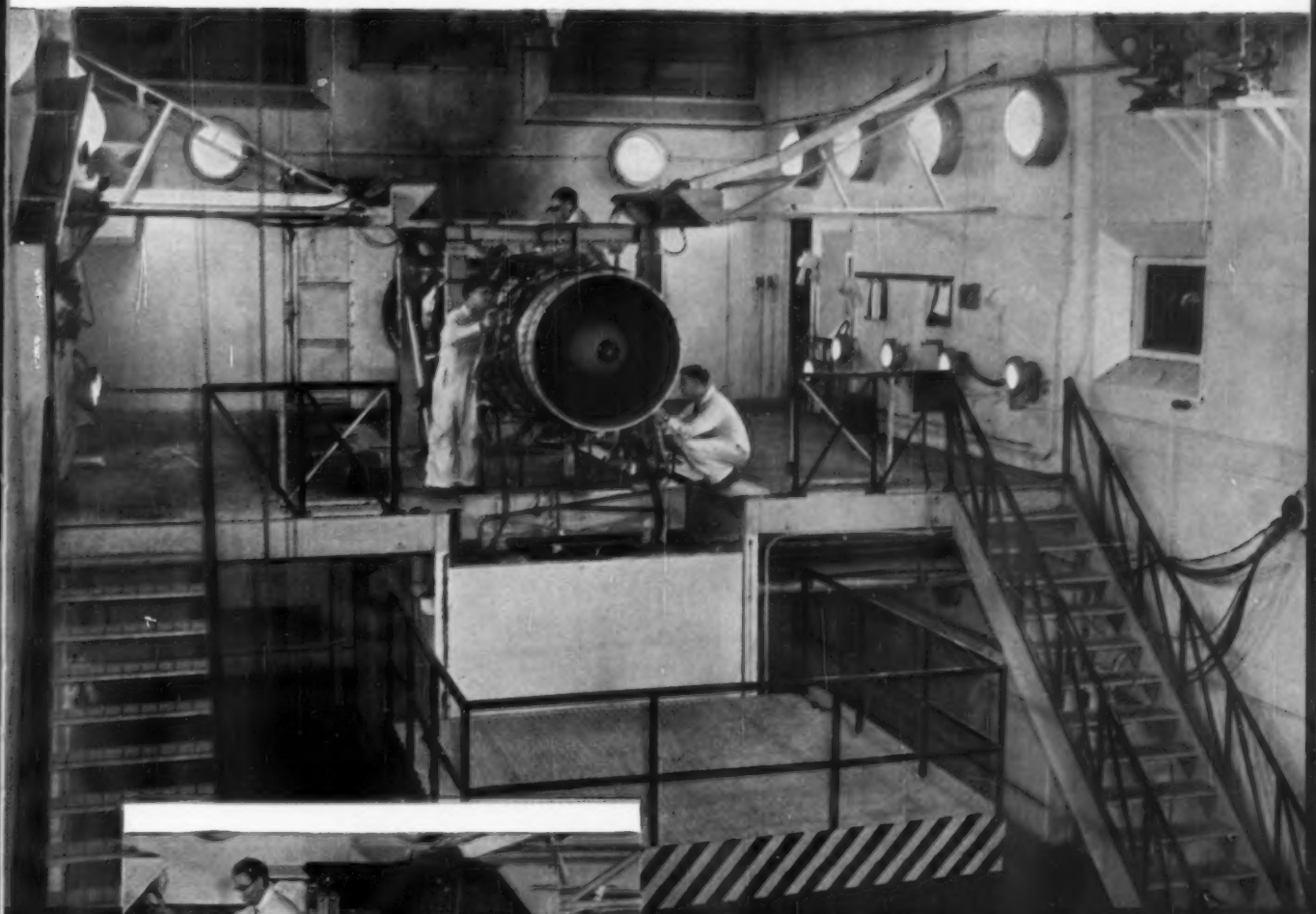
Assembly would take place at Donauworth, where Siebel ATG is now turnto numerous Flick holdings spread around Germany as well as to the southern group.

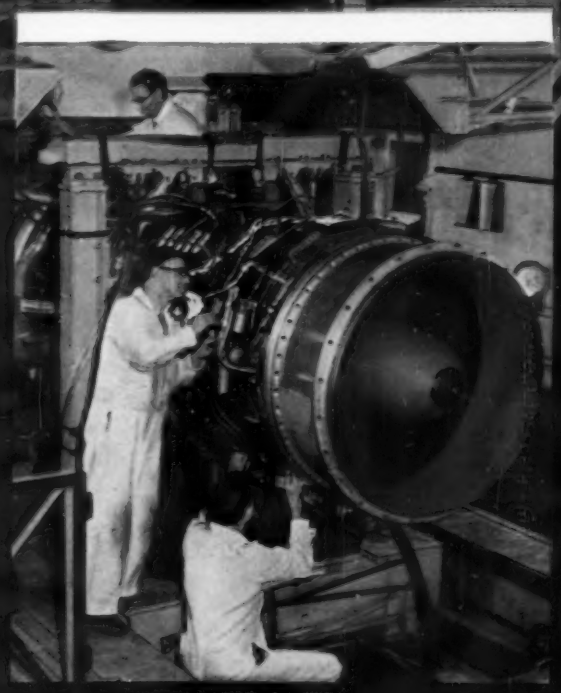
TAC Strike Force

Beirut—USAF Tactical Air Command composite striking force rushed to Adana Air Base in Turkey shortly after U. S. Marines landed in Lebanon now includes the following types of aircraft:

- **North American F-100D fighter-bombers of the 354th Tactical Fighter Wing commanded by Col. Francis Gabreski and normally based at Myrtle Beach AFB, S. C.**
- **Martin B-57 light bombers from the 345th Tactical Bomb Wing, Langley AFB, Va.**
- **Douglas RB-66 reconnaissance planes from the 363rd Tactical Reconnaissance Wing, Shaw AFB, S. C.**
- **McDonnell RF-101 photo reconnaissance planes from the 413th Tactical Reconnaissance Wing, Shaw AFB, S. C.**
- **Boeing KB-50 aerial tankers employed to refuel the fighters and light bombers on their U. S.-Turkey flight.**

Rehearsal for Mach 3 at 100,000 feet





IROQUOIS development engines have completed over 5,000 hours of bench running in these test cells at Malton and in flight tests.

Over 100 hours were accumulated during a recent series of test runs at the NACA Lewis Flight Propulsion laboratory, Cleveland, Ohio.

Further tests will be conducted in Orenda's new high altitude facility to investigate IROQUOIS performance over the widest range of speed and altitude.

IROQUOIS test results at NACA Lewis Flight Propulsion laboratory, Cleveland, U.S.A.

1. Probably highest dry thrusts recorded in North America for turbojets.
2. Successful operation under sustained high inlet temperatures.
3. Normal relights up to 60,000 feet, the limit of the tunnel, proved effectiveness of Orenda patented method.
4. Altitude handling improvements incorporated within two months.
5. Thrust/weight 5:1.
6. Thrust—in the 20,000 lb. class (without afterburner).

ORENDA
ENGINES LIMITED
MALTON, CANADA

MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

terplanetary exploration vehicles and studies relating to lunar exploration.

Peale said the program also will "intensify studies designed to extend the capabilities of the F-105 fighter bomber," which Republic is building for the Air Force. In the missile field, Peale added the company has "no intention" of duplicating activity under way by other firms, but will concentrate on development of new concepts in space-to-surface, surface-to-surface, anti-submarine and long range air-to-air missiles.

The company, he said, already has started work on missile systems capable of destroying a satellite or orbiting weapon.

"Our long-range objective," Peale continued, "is to capture a position of leadership for the company in the field of astronautics."

Republic's program has been under intensive study by the firm's Scientific Research, Engineering and Development staffs. Future projects envisioned by Republic include vertical takeoff fighter-bombers, intercontinental supersonic bombers and supersonic cargo aircraft, Peale continued.

Kincheloe Crash Raises Control Question as USAF Probe Continues

Edwards AFB—Actual cause of the accident which resulted in the death of Capt. Iven Kincheloe here remained officially undetermined last week as USAF investigators probed wreckage.

Kincheloe, who was to be USAF project pilot on the North American X-15, was killed when his parachute failed to completely open after a low level ejection from an F-104A shortly after takeoff on a support flight July 26.

Information so far indicates there was no complete loss of power as in a flameout. Partial power theory is supported by report that Kincheloe apparently was calm in announcing he was leaving the aircraft.

Expert opinion has it that Kincheloe rolled the aircraft to the inverted attitude for ejection due to his low altitude, indicating also that some degree of lateral control was still available. Expert opinion also is that Kincheloe was lower than 1,000 ft. above ground when the trouble started, although his highest point was unknown.

Lacking was reliable information as to the airplane's angle toward the ground, or its speed. One eyewitness told investigators the plane appeared to be going 300 mph. and looked like it was landing. His viewing position was almost headon and he did not see the actual bailout. He described the plane's course as from north to southwest which, in conjunction with impact point, indicated Kincheloe was headed away from Rosamond Dry Lake.

Efforts to check out all parts of the flight in relation to geographic position and what was happening, still leave a blank span of approximately 30 sec. which is indicated to have been after Mayday call and before impact. It would have been during this blank time that critical point in flight was passed.

Accident brought into sharp focus the question of automatic controls for variable stators and inlet guide vane of F-104A's J79 turbojet engine (AW Feb. 10, p. 81). Reports are that pilots have urged substitution of manual for the automatic controls for the inlet geometry and AVIATION WEEK has learned that there was a probability of the aircraft being grounded until USAF investigators resolved the question of whether this was seat of the problem and manual controls are the proper fix.

AVIATION WEEK has learned that a proposal has been made and is now being studied, for incorporation of a cockpit-located, pilot-operated manual override switch for the variable geometry inlet controls.

Now being phased into production aircraft is a pilot-operated override switch for the variable geometry exhaust nozzle.

These variable geometry features are among the design innovations in the J79 which contribute to the engine's performance, and the automatic controls, when working, are excellent. Use of pilot overrides for emergencies are expected to contribute materially to clearing up problem areas.

USAF Space Agency

Washington—Air Force last week created the separate space agency that had been abruptly cancelled by Defense Department after a few days' existence last December.

Brig. Gen Homer A. Boushey named to head the new post of Director of Advanced Technology also commanded the short-lived Directorate of Astronautics last year (AW Dec. 23, p. 18; Dec. 16, p. 26). Establishment of a separate space agency had been opposed in December by William M. Holaday, the Defense Department's director of guided missiles, in testimony before a Senate committee. Holaday said the Air Force action at that time "jumped the gun" in consolidating its advanced space projects. Other Defense Department officials backed Holaday in his belief that no action should be taken until the Defense Department had established its Advanced Research Projects Agency.

Boushey's new office will work closely with the Advanced Research Projects Agency, according to the new announcement. In the Air Force chain of command, Boushey will be under the Deputy Chief of Staff Development.

Soviet Space Study

Moscow—Russians are seriously discussing vehicles that would use the electromagnetic fields in space as an energy source for propulsion. G. I. Pokrovskiy, member, of the Soviet space flight commission, says in the Soviet journal "Teckhnika Molodezhi" that the particle accelerators necessary to utilize the energy in these fields exists though not in the specific form that would be needed by a space vehicle.

Pokrovskiy says two devices would be used—one to accelerate positive particles and the other negative particles. He explains that, if the vehicle were in a cosmic electric field with the positive accelerator turned on, the ship would gravitate toward the negative pole of the field. Direction of motion would be controlled by changing the charge on the ship.

Concerning the relation between the energy required to operate the accelerators and the energy available in the magnetic fields in space, Pokrovskiy says, "The energy to emit the ions may be obtained from irradiation or from a small supply of fuel. The energy of this fuel will be inconsiderable in comparison with the energy latent in cosmic magnetic fields which can be used to drive a ship. . . ."

Senate Group Boosts Defense Budget

Washington—Senate last week voted Department of Defense $1.2 billion more than it asked for in its Fiscal 1959 budget. The appropriation was accompanied by an admonition from the Senate Appropriations Committee to cut military contractors' costs.

Directing a report on steps taken to achieve this by next Jan. 15, the committee said that it is "gravely concerned over the inability of the Department of Defense to provide a checkrein on increasing costs of contracts with private industry." It added:

"It is recognized that in a period of generally rising prices, increased costs are inevitable. However, there is considerable substantiation to the belief that there is little incentive to private

BENDIX* IGNITION SYSTEMS—FOR THE BEST IN JETS

General Electric's J79 jet engine—an engine capable of powering aircraft at twice the speed of sound—incorporates an ignition system designed and manufactured by Scintilla Division, of Bendix Aviation Corporation. Years of ignition design experience have made Scintilla Division a primary source for reliable ignition systems used in the newest and finest military aircraft.

The J79 is General Electric's answer to the need for a high-thrust, low-weight, jet engine for today's and tomorrow's high performance aircraft. Due to its outstanding thrust-to-weight ratio, this engine has a wide range of applications, including guided missiles, bombers, fighters and commercial aircraft. In addition to its high performance capabilities, the J79 features installation flexibility, maintenance simplicity and uses a minimum of critical material.

Serviceability, reliability and extended overhaul life are inherent features of Bendix-designed jet engine ignition systems.

Canadian Affiliate: Aviation Electric Ltd., 200 Laurentien Blvd., Montreal 9, Quebec.
*TRADE MARK

Scintilla Division
SIDNEY, NEW YORK

Bendix
AVIATION CORPORATION

industry to hold down spiraling defense contracts. Automatic accessions to labor demands are made by industry, knowing that these increases will not require absorption but will be passed on to the government. . . . The pirating of technical employes and skilled workmen has been much publicized, the cost of which ultimately is absorbed in government contracts. The general lack of a pressing need for economical production, once competitive marketing is removed, is inimical to the public interest, and weakens our defense armor."

The Senate committee's boost would bring the Fiscal 1959 defense budget to over $40 billion—$5.5 billion over the Fiscal 1958 budget.

Fund increases made to the Department's request included:

- **$108.7 million for 13 B-52G** bombers.
- **$111.2 million for 30 KC-135** tankers.
- **$140 million for strategic airlift** aircraft.
- **$90 million for Minuteman** multipurpose ballistic missile program—$15 million for research and development and $75 million for procurement.
- **$48 million for Hound Dog** air-to-ground missile to equip B-52 forces.
- **$709 million for Navy's Polaris** fleet ballistic missile program. This represents $683 million for four submarines, $71 million for research and development.

First DC-8 Logs 45 Flight Hours

More than 45 hr. of flight time has been logged on the first production model of the Douglas DC-8 in the two months since the first flight May 30. This compares with 35½ hr. on the DC-7 and 49 hr. on the DC-7C during the first two months tests.

R. L. Hoskinson, director of Douglas' testing division, said that tests accomplished to date are most satisfactory. Total flight time of 45 hr. 10 min. through July 29 was divided into 13 flights, each of increasing duration. Flights 12 and 13 each were 5½ hr. duration. Maximums attained were Mach .85, true airspeed of 505 kt. or more than 580 mph., altitude 36,000 ft. The DC-8 has carried a full load and has taken off at a gross weight of 225,000 lbs.

Vertol 44 Aids In Oil Search

New Orleans—A single amphibious Vertol V-44 helicopter, pioneering new techniques of oil search and exploration in the rugged marshlands of the delta region at the Mississippi River's mouth, may provide the petroleum industry with the breakthrough it is seeking to economically pinpoint untouched resources, at the same time spark a vital new market for rotary wing aircraft to match the record set in the offshore region near here.

Experiment is being watched particularly by Vertol, who has been seeking hard to crack the oil industry market now heavily served by Sikorsky and Bell. Mid-East crisis is certain to spur oil search and exploration activities in less vulnerable areas, as it did at time of Suez crisis a year ago, a source close to the international petroleum industry told AVIATION WEEK.

New project, started here late last month on a 30-day trial basis by Pan American Oil Co., involves charter of V-44 under contract from Indair, Inc., a New York-based helicopter operator formed to provide rotary wing airlift for the petroleum industry on a package basis, supplying helicopters, crews and maintenance. V-44 is being flown by Vertol Aircraft Corp. pilot Al Temple, loaned to Indair for the project.

Current operation involves airlift of heavy-duty onshore-type petroleum exploration equipment and technicians into marshland areas so soft in most cases that terrain cannot even support a man's weight. Goal is to see if the large tandem-rotor cargo type V-44 will be practical in replacing slow, cumbersome marsh buggies and boats, which have been the main means of working this area. In an effort to slash costs of slow and inefficient surface transport, small Bell 47 helicopters have been tried, and found wanting, according to an on-the-scene observer. Their primary disadvantage: small payload has necessitated use of lightweight "Mickey Mouse" search gear, usually a compromise and of too small caliber for the job.

Indair's V-44, operating from a barge, has been airlifting fullscale 3,000-lb. seismograph recording shacks and their attendant equipment and cable, also 3,200-3,500-lb. on-shore drill rigs slung under its fuselage on the cargo sling.

Equipment is mounted on platforms providing working space for technicians; these stands are fitted with Bell helicopter rubber float gear to sustain them on soft ground or water, enabling them to be located precisely where they are needed.

When obstacles do not permit exact placement of equipment, it can be lowered to surface in a more favorable area, towed to spot desired; also, if relocation nearby is desired, tow can also be used. V-44 has shown good towing capability, the twin-rotor configuration lending itself to pulling equipment across even roughest type of surface.

Research Pool

General Motors' experience in the ical Co. and Thiokol Chemical Corp. have entered into a working agreement to jointly develop advanced devices for guided missiles and space travel.

The three-way agreement calls for a pooling of resources for missile and space work but leaves each company free to seek work on either a prime or subcontracting basis. It is not intended to restrict the individual research, sales or production programs of the separate companies.

When the combine does seek contracts as a unit, the research and development facilities, personnel and mass production capability of the three firms will be offered in the most advantageous combination for the job at hand.

General Motors' experience in the guided missile and space field centers is primarily around air-breathing engines, guidance systems, missile components and structures. Callery produces propellants and boron fuels. Thiokol has a wide background in solid fuel rockets and through its newest acquisition, Reaction Motors, a liquid fuel rocket capability.

News Digest

Rocketdyne Division of North American Aviation, Inc., has received a USAF contract to develop a 1 million lb. thrust liquid propellant engine. In its final stage the engine will produce approximately 1.5 million lb. thrust.

Two Navy balloonists last week successfully flight tested a sealed, sea-level pressure cabin system that will be used with a 16-in. telescope next November for spectrographic studies of the atmosphere of Mars.

Canadair Ltd. is negotiating with Brazil for sale of about 100 of company's Canadair 540 turboprop air transports. Deal is contingent on Canadair building and operating a production plant in Brazil. Sales contract would be worth about $100,000.

Willis Player, American Airlines vice president, has been named to head the company's public relations department. He succeeds Rex W. D. Smith, who has held the position since 1946 and retired.

Funeral services for Lt. Gen. Claire L. Chennault, USAF, ret., were held last week at Arlington National Cemetery near Washington following his death of lung cancer in New Orleans.

AMERICAN Airlines Convair 600 transports show area rule bulges behind inboard engines, raising cruise speed to 635 mph.

American Orders Area-Ruled Jetliners

By Glenn Garrison

New York—American Airlines has placed orders for two types of medium range jet transports—one of them a revolutionary new design—and has entered into a unique lease arrangement with three engine manufacturers for 441 gas turbine engines.

As predicted in AVIATION WEEK (July 21, p. 33), the carrier is buying Convair Model 600 jets incorporating area rule and equipped with General Electric turbofan engines. In addition to 25 of the 600s for 1961-62 delivery, American has ordered 25 intermediate range Boeing 707-023s with first deliveries expected in the first half of 1960. The airline's original order of 30 long-range Boeing 707-123s has been cut to 25 with the new round of medium jet orders. Options have been taken on an additional 25 Convairs and 25 Boeing 707-023s.

American Airlines Jet Specifications

	Boeing 707-123	Boeing 707-023	Convair 600	Lockheed Electra
Passengers	100-150*	90-130*	90-120*	68
Cargo Capacity	1,670 cu. ft.	1,340 cu. ft.	637 cu. ft.	565 cu. ft.
Speed (cruising)	585 mph.	601 mph.	635 mph.	407 mph.
Engines	Four P&W JT3C-6 turbojets	Four P&W JT3C-7 turbojets	Four GE CJ805-21 turbofan	Four 501D-13 Allison turboprops
Static takeoff thrust	13,000 lb. (wet)	12,000 lb. (dry)	15,000 lb.	3,750 hp.
Max. gross Takeoff weight	247,000 lb.	202,000 lb.	238,200 lb.	113,000 lb.
Fuel capacity	15,450 gal.	11,500 gal.	15,200 gal.	5,400 gal.
Interior cabin Width	142 in.	142 in.	128 in.	128 in.
Length	144 ft., 6 in.	136 ft., 2 in.	139 ft., 6 in.	104 ft., 6 in.
Wingspan	130 ft., 10 in.	130 ft., 10 in.	120 ft.	99 ft.
Tail height (from ground)	38 ft., 7 in.	38 ft., 4 in.	37 ft., 6 in.	32 ft., 9 in.

* Depending upon interior seating arrangements.

The leasing arrangements with Pratt & Whitney, General Electric and Allison Division of General Motors respectively cover JT3 engines for the Boeing 707-023s, CJ805-21 engines for the Convair and Allison 501D engines for the Lockheed Electra turboprop. A total of some 441 engines are involved in the leases and rentals will amount to about $67 million. American President C. R. Smith said the airline will save about $80 million in capital expenditure through the lease plan involving fewer spare engines and parts and a faster pipeline.

Allison's leases will run for a five year period from the date of the Electra's entry into revenue service. The other two leases will extend for seven-year periods from start of service.

Smith said the Pratt & Whitney engines were priced at about $155,000 each, the General Electric powerplants at $198,000, and the Allisons at $89,500. Both of the newly-ordered medium jets cost about $3.2 million without engines. Total cost of American's turbine aircraft orders now stands at $365 million. Smith said the carrier's piston fleet remaining after the last jet deliveries in 1962 would probably total about 50 planes.

No additional financing was necessary for the new orders because of the lease arrangement, Smith said. American has the option to buy the leased engines at their amortized value at any time, but not for less than 10% of the normal purchase price.

Convair's Model 600 transport de-

sign represents a basic design change over the earlier Model 880 prototype now under construction at San Diego. Model 880 has been ordered by Trans World Airlines and Delta Air Lines. Main characteristic of the Model 600 design is application of Richard Whitcomb's NACA area rule which raised the transport's Mach number from .89 to .91 and a cruising speed of 635 mph. compared with 600 mph. for the Model 880. The Model 600 also has a larger wing area, longer fuselage, higher gross weight and bigger payload than the Model 880. With the 15,000 lb. thrust General Electric turbofan engines and the new design features the Model 600 will require about 1,000 ft. less runway for maximum gross takeoff than the Model 880.

The area rule application is visible in the two bulges protruding from the trailing edge of each wing on each side of the inboard engine pylon. The General Electric turbofan engine is now running on test stand at the Evendale, Ohio, plant of the Aircraft Gas Turbine Division. It will be equipped with silencers for the Model 600 installation.

American Airline spokesmen said the Pratt & Whitney Aircraft turbofan version of the J57 was about a year and a half behind the General Electric turbofan in its development but that Pratt & Whitney's turbofan would make an excellent retrofit engine on American's long range Boeing transports.

American's Convair 600s will seat 90-120 passengers, according to the airline. The Boeing 707-023's capacity is 90-130 passengers.

Reduction from 30 to 25 in American's 707-123 jet order was made because the original number was no longer needed, Smith said. The long-range order was originally larger than necessary but there were no shorter range jets available at the time.

All the jets will be equipped with noise suppressors, although the turbofan engines are quieter and will need less suppressing, according to Smith. American expects its first 707-123 training aircraft in October, five or six production models by the end of 1958, and start of scheduled New York-California service in December. Smith said he had observed the full-load noise tests of the 707 last month in Seattle and the results seemed good to him. The Port of New York Authority has maintained that evaluation of these tests will determine whether the 707 is suitable for regular operations at New York. Such evaluation is still in progress by the agency (AW July 21, p. 30).

"I don't think there's any doubt that the 707 will operate at Idlewild," Smith said, although he pointed out that some operating restrictions probably will be imposed.

Jet operation from other New York airports also is likely, Smith said, although LaGuardia must be reconstructed before the aircraft can operate there. The Convair 600, he said, will need 10-15% less runway than the small Boeing.

American expects ground support equipment for its jets to cost about $15-17 million. This is less than the $25 million cost estimated last fall by Smith (AW Nov. 4, p. 40). More detailed planning has provided enough information to revise the estimate.

Use of three different types of straight jet aircraft in addition to the Electra is not expected to cause problems with maintenance or more expensive ground equipment, Smith said. The airline's order was divided to take advantage of the different capabilities of the aircraft types, he added. The 707-023 will operate over intermediate distance, as will the Convair 600. The Convair, however, will be capable of operating nonstop transcontinentally.

American hopes to set 800 hr. between engine overhauls for its first 707-123 operation and increase that time to 1,000 hr. Civil Aeronautics Administration, however, is presently holding out for 600 hr., Smith reported.

American, Allison Lease Plan Establishes New Financial Pattern

By L. L. Doty

Indianapolis—Agreement between American Airlines and Allison Division of General Motors whereby the carrier will lease rather than buy the 162 turboprop engines needed to power its fleet of Lockheed Electras marks a drastic change in traditional airline-manufacturer relationship.

It marks the first time in history that a U.S. air carrier has laid down plans to reduce capital expenditure by sacrificing direct ownership of equipment. According to one manufacturer, the agreement could set a pattern that would give the airline industry the lift it needs in moving into the period of jet operations during the initial phase of high costs and heavy capital commitments.

The Allison-American contract predicted by AVIATION WEEK last spring (AW May 12, p. 41) has not been formally signed, but both parties expect that final documentation of the transaction to be completed within 30 days.

Under the plan, a wholly owned subsidiary of General Motors will be established. The leasing subsidiary will purchase the engines from Allison and contract directly with American Airlines for the rental of the engines under a five-year lease.

Financing will be handled through banks with General Motors assuming only a small portion of the backing of the engine purchase. Overhaul of the 501-D13 turboprop engines by the manufacturer at its plants here will be included in the unprecedented agreement. The contract covers both spare engines and those to be delivered to Lockheed for installation on the Electras.

The contract will carry an option permitting American Airlines to purchase the engines at any time during the life of the lease. Purchase price will be based on the age of the contract and the rental rate. In effect, American, if it chooses to buy the engines, could apply at least a part of paid rental fees to the purchase price of the engines.

A final rental rate has not yet been fixed by the two companies.

American will handle all insurance coverage and assume full responsibility of the engines just as though they owned them.

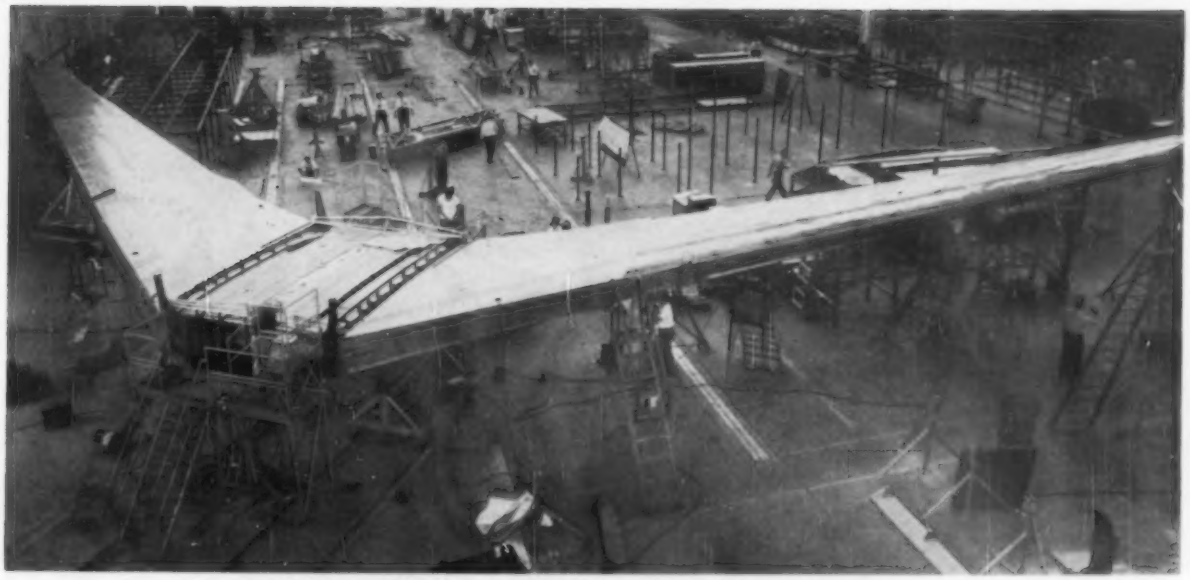
Under the engine overhaul arrangement, engines will be shipped by American to Allison at the established overhaul time of each engine. According to the Civil Aeronautics Administration, no overhaul time has been set as yet for the engine. It is at the present time undergoing certification tests.

American Airlines Jet Orders

Aircraft	Powerplant	Delivery Date
25 Boeing 707-123*	Pratt & Whitney JT3 turbojet	1958-1959
25 Boeing 707-023*	Pratt & Whitney JT3 turobjet**	1960-1961
25 Convair 600	General Electric CJ805-21 turbofan**	1961-1962
35 Lockheed Electra	Allison 501D turboprop**	1958-1960

* Revised from original commitment for 30 when order for medium-range model was placed.

** Engines to be leased by American from the manufacturer.



Convair 880 Jet Transport Wing Mated

Right and left wing sections of Convair 880 jet transport are mated at San Diego plant of Convair Division of General Dynamics Corp., after sections had been baked in a specially-built oven to assure leakproof integral fuel tanks. Wing mating is first station on Convair 880 assembly line. Wing has a spread of 120 ft., a sweepback of 35 deg., and a dihedral of 7 deg. Eight integral fuel tanks have a total capacity of 10,770 gal.

CAB May Act to End Third-Pilot Dispute

By Robert H. Cook

Washington – Civil Aeronautics Board action may be the final factor in settling the hotly-debated third crew member issue which has drawn seemingly different findings from two presidential fact finding panels investigating the problem at Eastern and Trans World airlines.

While the Board in the past has adopted a hands-off policy in the running battle between the Air Line Pilots Assn., the Flight Engineers International Assn. and the airlines on the grounds that it has been a labor-management dispute, CAB has now turned both emergency board reports over to its Bureau of Air Safety for study. Affirmative findings by the Bureau, requiring flight engineers on turbojet transports to be qualified as pilots, would "undoubtedly" result in a change in Civil Air Regulations making such qualifications mandatory, according to a CAB spokesman.

Turning point in the issue came with an emergency board finding in the ALPA, FEIA, Eastern disagreement that third crew members should be pilot qualified in order to assume control of the aircraft in the event of an emergency (AW July 28, p. 32). The report said that flight engineers on piston-engine and turboprop equipment would continue to serve without meeting pilot requirements. It added that flight engineers taking pilot training would probably do so on their own time but at company expense.

Pressing the importance of the safety factor involved in the dispute, the presidential board observed that, while the Civil Aeronautics Board's safety order in 1948 establishing the need for flight engineers and their requirements, can be met with either pilot qualified or mechanic qualified engineers, ill feeling between the two unions posed a threat to the degree of cooperation "vital in operations as critical as that of flying airplanes."

TWA Ruling

Emergency board considering the Flight Engineers International-Trans World Airlines investigation case recommended that a flight engineer, as well as two pilots, should man TWA jets. Dudley E. Whiting, sitting as sole member of the board, said the proposal should settle any disagreement between the union and the airline and recommended that TWA continue its policy of setting its own standards for flight engineers as it has for the past 19 years.

Recognizing the possibility of government intervention in the third crew member problem, the board said that if Civil Air Regulations should be changed to require pilot qualifications for flight engineers, it would be "no fault of the company" and the expense of training should be borne at the engineers' expense and on their own time. Should the airline change its existing qualifications, then the flight engineers should receive pilot training at company expense, the report said.

The board also recommended inclusion of a clause that flight engineers should be selected from the FEIA seniority list at TWA as job security against any change in present government regulations, provided the airline agrees not to enter into a contract concerning the engineers with any other union.

If the government makes the pilot requirements mandatory, Whiting said, TWA probably would have difficulty in hiring qualified personnel from the engineers' ranks and should, therefore, be allowed to hire men with the necessary qualifications wherever possible.

Engineers' Stand

Safety did not enter into the discussions or recommendations at TWA as it did in the Eastern case, making the case primarily a matter of job security, according to spokesmen for the Flight Engineers International Assn., which pointed out that Whiting was confronted only with a TWA-flight engineers agreement that the third man would be a flight engineer, making it unnecessary for his report to go beyond the accepted agreement.

Air Line Pilots Assn. and the Flight Engineers were both involved in the

A progressive maintenance system will permit American to pull each Electra off the line for nothing more than a single engine change when overhaul time of an engine has been reached.

Overhaul expense to American will be based on day-by-day overhaul costs in relation to fleet flight hours. Allison plans to set a maximum overhaul cost ceiling over which the manufacturer will assume all responsibility.

Several other airlines have approached Allison with similar propositions but as yet no firm commitments have been made. Allison wants to wait until the American agreement is under way before it signs other agreements as a means of developing a base pattern for any future commitments it may elect to make.

Allison points out that it did not originate nor pioneer the program but acted solely on the proposal for a rental plan presented by American. According to Allison officials, other carriers became interested and queried the manufacturer about the plan when word spread within top-level industry circles that discussions with American were being held.

If Allison does enter into similar agreements with other carriers, each case will be handled on its own merits. Terms for each carrier will vary and each agreement will probably call for the creation of a separate leasing subsidiary.

Future Agreements

Financing problems and credit position of the airline coupled with the competitive need of Allison to make such an arrangement in order to secure a sale will be the determining factors in making a decision on future agreements. The operation of the American agreement, however, will serve as a guideline in documenting other agreements.

Allison officials admit their first preference is to sell engines for cash. However, the company realizes that competition with other manufacturers may force it to expand the program as more turboprop fleets are placed into operation. For this reason, Allison is not promoting the plan nor using it as a selling device but is openly expressing its willingness to talk with potential customers about such agreements.

Actually, Allison is hopeful that an independent company will eventually be organized to underwrite leasing programs. The need for such an organization is borne out by the fact that three engine manufacturers have been forced into the American leasing program with most companies expecting more to come.

Because of the nature of the program, lease contracts are likely to be confined by Allison to domestic carriers. Although the company will undoubtedly consider proposals from the larger foreign flag carriers, it is not presently viewing such possibilities as practical because of currency exchange and other financial complexities involved in international transactions.

American's Purpose

Chief purpose of American Airlines in originating and developing the plan is to reduce capital commitments. In effect, the airline wants to operate its turboprop and turbojet equipment without tying up a large volume of capital funds in powerplants, spares and parts inventory. One estimate places the savings to American in capital commitments as a result of the leasing agreement at $80 million.

The airline will be spared additional capital expenditures for the construction of overhaul facilities by turning over engine overhaul activities to the manufacturer. Elimination of parts inventory costs, alone, will result in a substantial reduction of capital expenditures.

The agreement underscores the serious problems the airline industry faces in financing the turbine-powered equipment that competition is forcing both trunklines and local service carriers to buy. In its effect on financial capability, it is comparable to the pattern recently set by aircraft manufacturers in accepting trade-ins on the purchase of jet aircraft (AW July 7, p. 26).

A number of airline officials feel the period of jet operations arrived sooner than was anticipated by most carriers and arrived virtually in one package rather than in a staggered fashion.

For example, American is faced with the prospect of introducing for the first time in airline history two completely different types of equipment at the same time. Both the Allison turboprop powered Lockheed Electra and the Boeing 707 turbojet transport will be launched into scheduled service almost simultaneously.

In addition, most carriers are now able to place a better estimate on operating and maintenance costs of jet equipment and on spare parts requirements. It has become evident to the industry that a serious shortage of funds is threatened if the over-all jet program is to move on schedule unless some outside help is made available.

That additional assistance may well come from the manufacturers, and it is highly possible that America's leasing arrangements with three engine manufacturers and the trend toward accepting trade-ins will open the way to a closer working tie between the builders and operators of jet aircraft.

No-Show Backers Ask CAB Help

Washington—Majority supporters of the three phase no-show plan are banking on Civil Aeronautics Board intervention to block a move by American Airlines to push adoption of a substitute plan at the November meeting of the Air Traffic Conference.

Five carriers, representative of the 22 out of 25 conference members favoring retention of the present plan's reconfirmation ruling, asked the Board last week to suspend and investigate an American tariffing which would allow the plan to expire by Dec. 1. The tariff, supported also by Mohawk and Allegheny Airlines, followed American's compromise agreement in May with ATC members to drop the penalty clause by Aug. 12 and the reconfirmation phase by December (AW July 21, p. 29).

Trans World, Eastern, National, Delta and Southern have requested CAB aid to avert abandoning the plan as a competitive measure which would result from American's plan of adopting an alternate "verification" system, which Eastern has labeled a "feeble and inadequate remedy."

Greatest concern of the carriers is that the Board may not have sufficient time to act on the suspension request before the Aug. 12 deadline for dropping the penalty phase. Delta, in particular, has said that the date is a "death warrant" for reconfirmation and charged that American intends to drop the entire plan then instead of waiting for the Dec. 1 date. Under the terms of a Civil Aeronautics Board approval of an ATC decision to drop the two phases on the agreed dates, the Board will lose all power to suspend the American tariff on Aug. 12, Delta claimed.

However, objectors to the American proposal pin their hopes for CAB action in the dispute on language contained in the recent approval granted with "certain reluctance" by the Board which added it was hopeful something would be done about the matter. Spokesmen for the government agency expressed "deep concern" over the disagreement and indicated the possibility of official action before August.

Delta also criticized an American survey designed to show that the reconfirmation ruling was an inconvenience to the public. "Despite the leading nature of the questions," the airline said, "84% of the passengers questioned indicated they had not been inconvenienced by the ruling."

Eastern discussion because of strike votes which were deferred by creation of the emergency board. ALPA was not a party to the TWA discussion but is currently negotiating a new contract with the airline and has announced that it will demand that third crew members be certified as pilots, regardless of the emergency board recommendations.

Meanwhile, TWA flight engineers last week signed a new contract with the airline to include the job security measures proposed by the presidential fact finding board.

New contract, which expires Jan. 1, 1961, calls for salary hikes of from nine to 14% on piston equipment, plus an additional 20% for jet work on Boeing 707s and Convair 880s. About 700 flight engineers are involved.

The engineers' union feels the Eastern agreement will be "miserable to all concerned" and terms ALPA's stand for a third member pilot for safety as "an old saw" to further the job security of pilots in the future. The union refuses to accept the board recommendation in this case and says it will "seriously consider" a strike vote after the 30-day waiting period imposed by presidential order.

American Airlines, now involved in a third man issue with ALPA before the Emergency Board, is strongly opposed to the Eastern findings, stating flatly "there is no need for the services of a third pilot."

C. R. Smith, president of the airline, said American will not use pilots in the third-man position unless directed to do so by the Civil Aeronautics Board. The airline has an agreement with its flight engineers which has nearly five years to run.

Antonov Defends Ukraina Design

Moscow—Soviet designer O. K. Antonov has vigorously defended the design of his four-turboprop An-10 Ukraina transport against Russian critics who complain that the high-wing aircraft looks old-fashioned and that its fuselage is too fat and heavy.

Writing in the official Russian civil aviation magazine, Grazhdanskaya Aviatsiya, Antonov retorts that, while the An-10's fuselage, with its six-abreast seating, seems fat when viewed from close up, the aircraft shows its true proportions in flight "and in our opinion is a pretty ship."

Admitting that the An-10's fuselage is somewhat heavier than fuselages in foreign transports of its class, Antonov says this is no cause for criticism since the Ukraina's payload is greater. In addition, he claims that the An-10's fuselage and tail sections are considerably sturdier.

Turning to the An-10's high-wing configuration, Antonov declared:

"Suspending the engines beneath the high wing increases the plane's lift-drag ratio by 2-3.5 units, depending on the condition of flight; decreases fuel consumption 10-15%; permits use of shorter, lighter exhaust stacks and cuts loss of engine efficiency through back-pressure.

"With the engines higher off the ground, foreign objects are less likely to be sucked into the compressors. Fuel trucks and other vehicles can easily pass under the propellers.

"Emergency landings on rough water would be safer in high-wing An-10 since the propellers would not impede fuselage's movement along the surface.

"Passenger entrance doors can be located more conveniently under the wing. With the fuselage nearer the ground, high loading ramps are unnecessary. The high wing permits a good view from all windows in the passenger cabin, and the sun's reflections don't glint in the passengers' eyes. . . ."

Russian Air Force newspaper, Sovetskaya Aviatsiya, says addition of outboard fins on the Antonov An-10 four-turboprop transport's stabilizer (AW Feb. 24, p. 38) was to correct instability which developed in the test model Ukraina at low speeds, "especially during takeoff."

British Airline Traffic, Capacity Increases

London—Although British airlines increased capacity in fiscal year 1957-58 by more than 15%, total traffic carried increased only 11%.

Figures published by Ministry of Transport and Civil Aviation show that the airlines offered 512.5 million ton-miles during the year, 15.1% more than in 1956-57. Total traffic rose to 314.8 million ton-miles.

While mail traffic remained at the 1956-57 level of 23.8 million ton-miles, freight traffic rose 9.7% to 56.7 million ton-miles. Four million passengers—an increase of 14.4%—flew 2,436 million passenger-miles or 13% more.

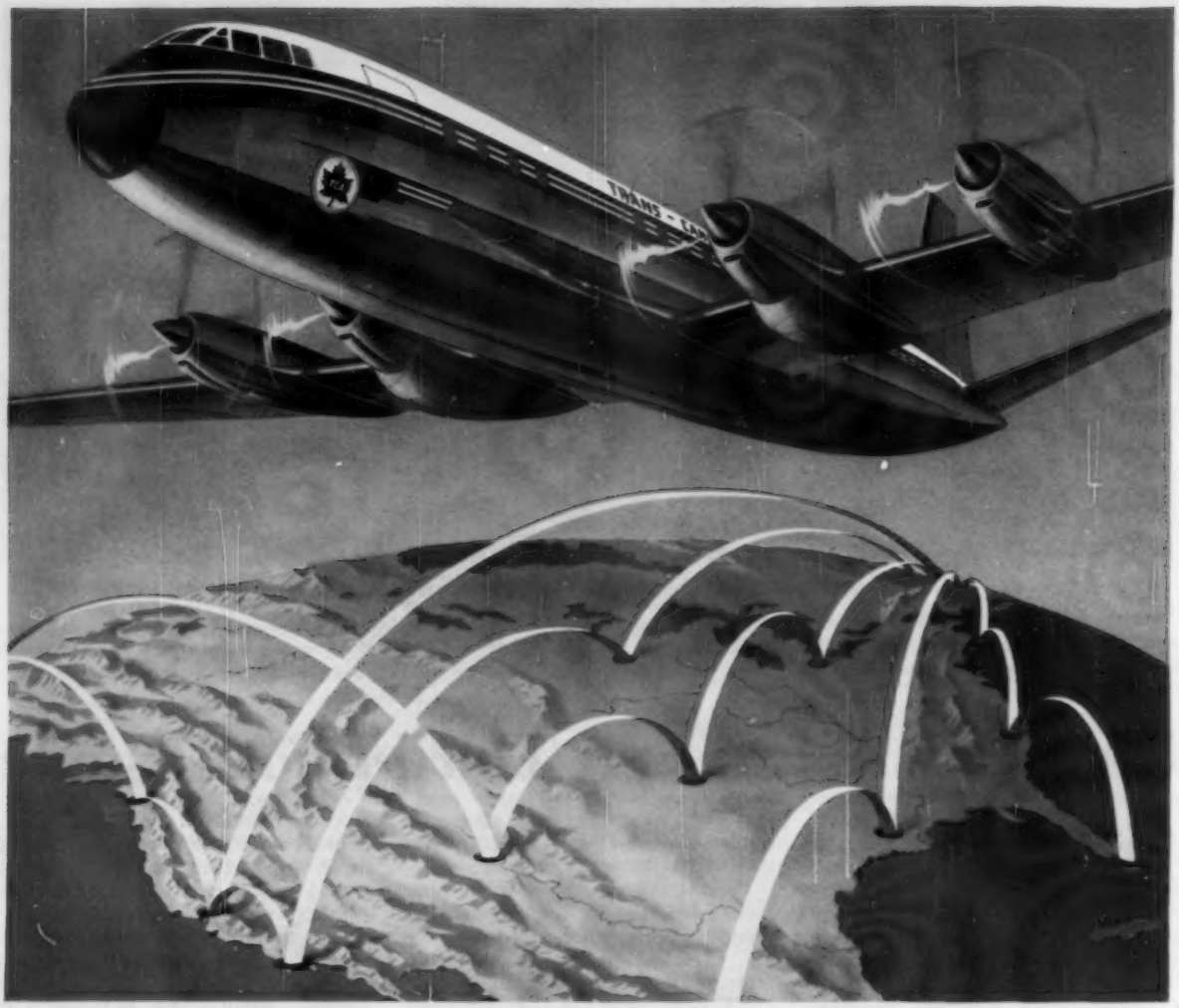
Over-all load factor for the year fell from 65.4% to 59.2%.

British Overseas Airways Corporation provided 313,283,000 capacity ton-miles, 13.9% more than in 1956-57. The airline flew 459,370 passengers—a 16% increase—1,327 million passenger miles, 10.5% more than in the previous year. Company's freight-carrying rose 6.4% to 8,911 tons. Mail dropped slightly, by .3%, to 4.134 tons.

British European Airways Corp. offered 159,466,000 capacity ton-miles on scheduled services, an increase of 15.4% above 1956-57. International capacity increased by 14.8%.

Japanese Design Turboprop Transport

Japanese turboprop transport, now being designed by Transport Aeroplane Designing Assn., has been designated YS-11, will carry 60 passengers. Aircraft will be powered by two Rolls-Royce Dart 10 engines, producing 2,665 eshp. each and prototype is expected to fly by November, 1959. Designers say YS-11 can also be designed in a four-engine configuration. Twin-engine design calls for cruising speed of 297 mph., range of between 374 and 622 mi. Project will cost estimated $10 million. Note high aspect wing ratio on YS-11 model. Aircraft previously was designated TADA.



WHY VANGUARD ASSURES GREATEST ROUTING FLEXIBILITY

The great new Vickers Vanguard will introduce the cost-cutting advantages of big payload capacity— plus the well-known economies of jet-props—on stages ranging from 200 all the way to 2600 miles. What's more, the new Vanguard can be operated from *any* "Viscount" airfield.

Economical on all ranges

TCA recently spent two years comparing the operating costs of several large-capacity Jet Age airliners—both jet-prop and pure jet. *They found that the Vanguard would be most economical of all for their high-density, medium-range routes.* Other studies have shown that the Vanguard, because of its large size and low break-even load factors—*below 50%* on ranges from 200 to 2600 miles—will offer the biggest profit potential of *any* aircraft in its class.

Double-deck fuselage

Another factor in the Vanguard's unequaled routing flexibility is its *double-deck* fuselage design which gives excellent balance between large passenger *and/or* freight capacity. In addition to the big, wide, comfortable passenger cabin above decks, there are two big lower deck cargo holds. These have a total area of 1360 cubic feet—enough to carry a 10-ton payload. Thus, during off-peak periods, the Vanguard can continue to earn revenue as a *freighter*—with *no* alterations! This represents a real competitive advantage to carriers with hourly, seasonal or directional routes.

An experienced Vickers engineering team, familiar with the operating problems of American carriers, is available for consultation at your convenience. Call or write: *Christopher Clarkson, U. S. representative, 10 Rockefeller Plaza, New York 20, N. Y.*

420 mph plus . . . 2600-mile range . . . up to 139 passengers . . . up to 10 tons of freight

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VICKERS VANGUARD

POWERED BY FOUR ROLLS-ROYCE TYNE ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LTD. • WEYBRIDGE, ENGLAND • MEMBER COMPANY OF THE VICKERS GROUP

SHORTLINES

▶ **Alaska Airlines** reports a net income of $410,147 for the fiscal year ending Oct. 31, 1957, in its annual report which was recently released. The 1957 net income compares with $391,302 for Fiscal 1956. An operating loss of $251,859 was offset by a capital gain from sale of aircraft and other income totalling $662,006. Revenues for the year were $5,663,977, off $347,206 from 1956.

▶ **Capital Airlines** is fighting sagging load factors with newly instituted "VIP" flights between New York and Chicago, Detroit, Atlanta and Birmingham and between Chicago-Washington and Washington-Minneapolis/St. Paul. At no extra cost, the flights offer cocktails, steak dinners and other deluxe service. The service is now available on 16 Capital dinner flights and is expected to be extended to other major points on the airline's system.

▶ **Los Angeles Department of Airports** has awarded a $927,968.90 contract for reconstruction of runway 25R at International Airport. The Griffith Co., of Los Angeles, low bidder on the project, began work on Aug. 1 and is expected to complete the job about Dec. 1. Since 1947, when airlines began using the municipally owned airport, nearly two million aircraft have used the runway for landings and takeoffs.

▶ **Transocean Air Lines** is operating an airlift under contract with Air Materiel Command to provide USAF divisions in the Far East with three million ton-miles of passenger and freight carriage during a three-month period. Transocean is operating a daily round trip flight linking USAF bases in Japan, Okinawa, Formosa, and the Philippines. The flight originates and terminates at Tachikawa AFB near Tokyo.

▶ **United Air Lines** flew 511,831,000 revenue passenger miles during June. Revenue airplane miles was 12,264,000; air mail, including first class, 2,383,000 ton miles; express 767,000 ton miles and freight 4,897,000 ton miles. All figures represent an increase except freight ton miles, which were 7% below those of June, 1957. United has signed air cargo interline agreement with two all-cargo airlines to cover through cargo movements over United's system and connecting carriers to foreign countries. The carriers, Aerovias Sud Americana and Sociedad Aeronautica Medellin, fly from Florida points to Guatamala, El Salvador, Panama, Colombia, and Ecuador and seven principal Colombian cities respectively.

AIRLINE OBSERVER

▶ Northeast Airlines will introduce its first Viscount turboprop service on Aug. 21 with four flights daily between Washington and Boston. As additional planes in its order for nine (AW July 21, p. 28) are delivered, turboprop service will be expanded to include hourly schedules between New York (LaGuardia) and Washington. The new schedule is a major step in the carrier's long range development program designed to establish greater identity in the East Coast market and to capture a larger share of the New York-Florida trade. In addition, Northeast hopes to balance out its relatively light midweek travel as opposed to its heavy weekend vacation traffic by attracting more business by Viscounts.

▶ **Proposed Lockheed turboprop airfreighter probably will bear little resemblance to the Electra transport and will require an initial order of at least 35 aircraft before production can be considered. While it would utilize the same Allison turboprop powerplants as the Electra, much of the design, such as end loading, will come from the C-130. Freighter also will be much larger than the Electra with a reported gross weight of 145,000 lb. as compared to 116,000 lb. for the passenger aircraft.**

▶ Pan American World Airways plans a domestic exhibition tour for its first Boeing 707 jet transport this fall before beginning transatlantic service. Domestic airlines are not happy about Pan American bringing the first jet transport to many of their major U.S. traffic points first and feel that the PanAm tour will take much of the steam out of their own promotional plans for inauguration of jet transport service.

▶ **Lockheed plans a seven week European sales tour for its turboprop-powered Electra this fall followed, by a promotional trip to the International Air Transport Assn. annual meeting in New Delhi, India, in October.**

▶ El Al Israel Airlines is borrowing one of the five Bristol 305 Brittanias ordered and then cancelled by Northeast Airlines. Bristol Aeroplane Co. announced the loan pending completion of El Al's fourth Brittania 313 early next year. Cost of the aircraft loan will be deducted from cost of the final 313, according to Bristol spokesmen. Authoritative sources in Tel Aviv report El Al also plans to replace its European route Constellations with medium range Comets or Caravelles soon.

▶ **Airways Modernization Board has awarded a $342,370 contract for a new and more detailed survey of air traffic conditions across the nation. Contract was awarded to the Chicago management consultant firm of Booz Allen and Hamilton. Estimated time to complete the task is six to 12 months.**

▶ Rolls-Royce Dart engines used on Trans Canada Airlines' Viscounts have been certified for a 2,000 hour overhaul schedule by the Canadian Department of Transports. TCA started Viscount operations in April, 1955, with approved Dart overhaul at 1,050 hours. Second highest overhaul life for the prop-jet engine is held by Capital Airlines which last May extended the overhaul period to 1,700 hours.

▶ **First BOAC de Havilland Comet IV jet transport last week returned to England from tropical trials in Africa including tail down take-off and icing tests. Comet IV flew the 3,210 mi. Entebbe-Rome leg of its return trip to Hatfield, England with full payload in 6 hr., 40 min.**

▶ Flying Tiger Line recorded the highest volume of airfreight ton miles flown by any U.S. carrier in April. CAB records show that the all-cargo carrier flew 8,202,771 ton miles. Its closest competitors, Pan American and American Airlines, flew 7,557,684 and 7,102,091 ton miles respectively.

▶ **Air France last week began direct service to Moscow with a twice-weekly schedule using Lockheed 1049G Constellations. Aeroflot began a similar operation using its Tu-104 jet transports. Tourist class fare between New York and Moscow is $508.70 one way, $915.70 roundtrip.**

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EXCLUSIVE

Dave Chasen, noted Beverly Hills restaurateur, approves a great entree.

Sirloin of beef... broiled to your order in flight!

Your Ambassador flight hums toward the evening sun. Dinner is served—a celebrated event on TWA. You begin with cocktails, you conclude with coffee, a choice of liqueurs, and a satisfied sigh. But the high point, an airline innovation by TWA chefs and Dave Chasen, is a culinary masterwork—a tender cut of prime sirloin of beef broiled in flight to individual taste. All this, of course, part of a most pleasant and rewarding trip by TWA Ambassador.

FLY THE FINEST... FLY **TWA** TRANS WORLD AIRLINES

Airline Income & Expenses—April, 1958

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenues	Total Operating Expenses	Net Income (Before Taxes)
DOMESTIC TRUNK								
American	22,329,684	571,513	2,041,621§	.....	79,906	25,148,240	23,457,209	1,963,353
Braniff	4,621,831	136,996	50,149	128,075	5,244	5,026,127	4,596,653	374,326
Capital	8,058,343	203,624	85,923	166,736	15,850	8,569,781	8,443,366	126,415
Continental	1,791,670	45,818	15,395	48,309	8,862	1,960,866	2,065,351	−104,485
Delta	6,939,130	155,782	73,213	258,249	.....	7,582,423	7,073,961	412,435
Eastern	22,243,485	342,175	.....	847,949	16,306	23,625,542	20,434,327	3,103,176
National	5,365,126	93,841	17,662	142,311	35,586	5,861,234	5,148,954	642,112
Northeast	2,020,933	32,388	12,938	37,716	.....	2,157,698	2,518,613	−406,139
Northwest	4,157,054	149,838	392,740§	.....	12,740	4,754,199	4,949,873	−195,673
Trans World	15,674,000	377,000	179,000	483,000	10,000	17,320,000	18,216,000	−859,000
United	21,401,505	884,859	266,935	972,574	.....	23,803,036	22,219,587	1,583,429
Western†	.....	.....	1,571	1,051	28,366	40,297	838,901	−871,458
INTERNATIONAL								
American	444,689	3,261	79,209§	.....	.....	541,051	579,700	−39,641
Braniff	495,097	1,112	.....	37,136	.....	574,386	707,050	−141,070
Caribbean-Atlantic	184,197	2,040	6,001§	.....	1,390	197,779	177,124	20,423
Delta	347,807	5,242	.....	13,903	.....	383,829	461,985	−84,296
Eastern	1,931,855	38,073	.....	61,811	96,152	1,928,741	1,745,891	175,706
Mackey	94,521	.....	.....	988	.....	103,339	121,773	−18,294
National	128,272	2,699	1,338	6,348	.....	144,384	236,982	−92,293
Northwest	1,615,289	528,393	328,276§	.....	41,543	2,610,376	2,228,998	381,377
Pan American								
Alaska	170,000	15,000	.....	59,000	.....	255,000	376,000	−121,000
Atlantic	9,615,000	612,000	.....	878,000	215,000	10,854,000	10,859,000	8,000
Latin America	5,053,000	167,000	.....	1,074,000	182,000	6,784,000	8,083,000	−1,321,000
Pacific	4,327,000	480,000	.....	558,000	592,000	6,330,000	5,915,000	418,000
Panagra	1,062,000	44,000	.....	149,000	.....	1,482,000	1,545,000	57,000
Resort	.....	.....	.....	.....	.....	577,889	510,390	67,499
Trans-Caribbean*	.....	.....	.....	.....	.....	.....	.....	.....
Trans World	4,412,000	494,000	.....	225,000	254,000	5,718,000	6,652,000	−1,021,000
UMCA‡	4,243	.....	784§	.....	.....	5,027	9,013	−3,986
United	868,587	34,671	.....	23,205	.....	941,201	875,097	66,104
Western†	.....	.....	.....	.....	.....	444	48,704	−52,013
LOCAL SERVICE								
Allegheny	466,937	15,341	7,699	14,315	83	1,067,586	751,396	316,190
Bonanza	242,201	3,579	1,447	4,234	3,167	390,340	381,349	10,153
Central	139,241	3,719	1,056	3,940	.....	356,359	359,427	−3,068
Frontier	369,714	198,958●	2,670	19,576	1,010	599,926	620,616	−22,732
Lake Central	159,637	4,473	6,471	.....	745	318,426	314,054	4,371
Mohawk	536,049	6,512	5,303	8,355	3,517	742,130	725,480	16,650
North Central	670,051	20,252	9,765	.....	24,228	921,804	1,026,222	−108,444
Ozark	402,112	295,896●	4,894	9,354	5,513	723,900	631,620	87,830
Pacific	367,759	10,322	3,583	2,909	14,788	547,160	569,744	−30,125
Piedmont	482,876	8,817	3,808	5,585	1,119	744,205	716,925	25,906
Southern	219,208	7,834	2,775	3,056	378	360,280	406,302	−47,783
Trans-Texas	274,804	9,634	2,988	11,056	4,767	522,449	533,507	−1,009
West Coast	230,999	4,176	1,996	3,191	1,638	391,061	407,609	−16,548
HAWAIIAN								
Hawaiian	400,211	3,941	.....	56,934	13,672	481,967	472,935	1,351
Trans-Pacific	184,335	590	.....	5,304	6,155	225,098	201,009	24,089
CARGO LINES								
AAXICO	.....	2,011	3,792	40,842	486,450	564,134	486,983	77,152
Aerovias Sud Americana	.....	.....	.....	157,813	22,020	182,993	180,577	2,416
Flying Tiger	.....	11,774	906,846‡	.....	1,771,634	2,676,486	2,303,685	131,215
Riddle	.....	4,945	365,163§	.....	433,696	801,951	989,608	−187,657
Seaboard & Western	.....	.....	.....	.....	.....	5,211,307	7,069,984	−1,858,676
Slick	.....	.....	.....	.....	358,109	527,752	698,199	−207,320
HELICOPTER LINES								
Chicago Helicopter	41,917	101,517●	.....	.....	.....	145,015	157,697	−12,682
Los Angeles Airways	14,770	11,871	5,733	.....	598	108,935	104,506	4,122
New York Airways	47,258	4,268	1,534	2,804	.....	195,202	228,015	−35,014
ALASKA								
Alaska Airlines	122,549	45,902	868	38,749	74,483	460,094	464,579	−13,795
Alaska Coastal	54,832	7,888	.....	8,817	2,355	110,359	118,552	−10,362
Cordova*	.....	.....	.....	.....	.....	.....	.....	.....
Ellis	.....	.....	.....	.....	.....	69,804	83,347	−13,884
Northern Consolidated	46,655	39,001	.....	24,744	7,713	171,837	197,176	−25,339
Pacific Northern	369,936	58,780	.....	63,303	3,949	738,843	765,116	−41,828
Reeve Aleutian	76,135	26,135	.....	23,731	44,510	170,777	128,054	40,659
Wien Alaska	56,403	41,268	.....	20,075	64,846	295,753	271,562	24,191

* Not available. † Western strike 2/21/58 to 6/1/58. ‡ Uraba Medelin & Central Airways. § Property figure. ● Includes Federal Subsidy.
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COMFORT: Spacious pressurized, air-conditioned cabin and vibration-free smoothness of synchrophased prop-jet power makes the ELECTRA outstandingly quiet and comfortable on long or short flights.

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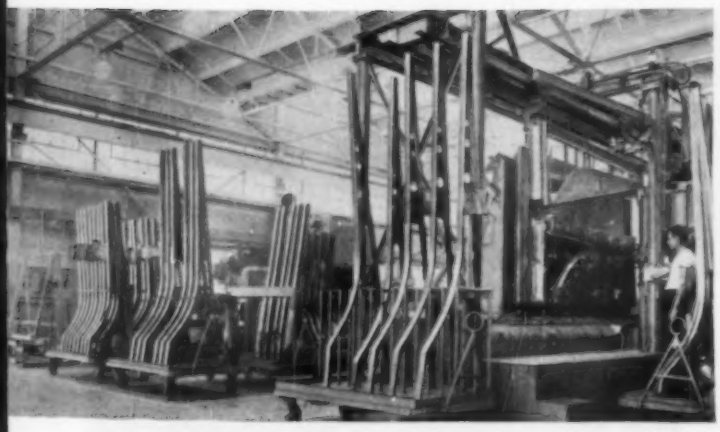

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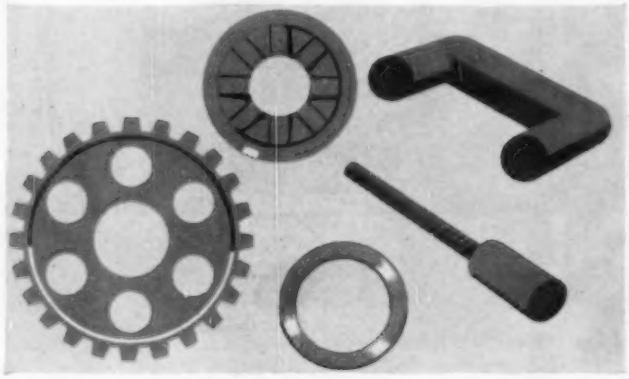

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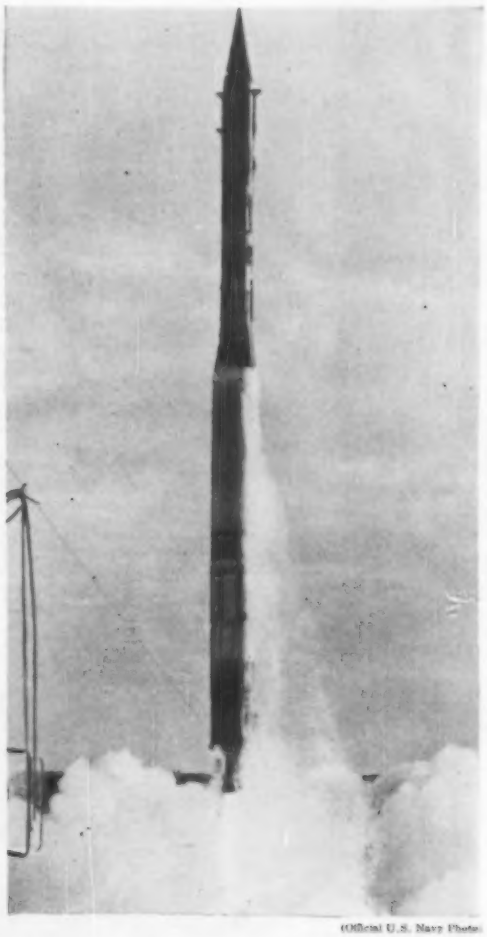

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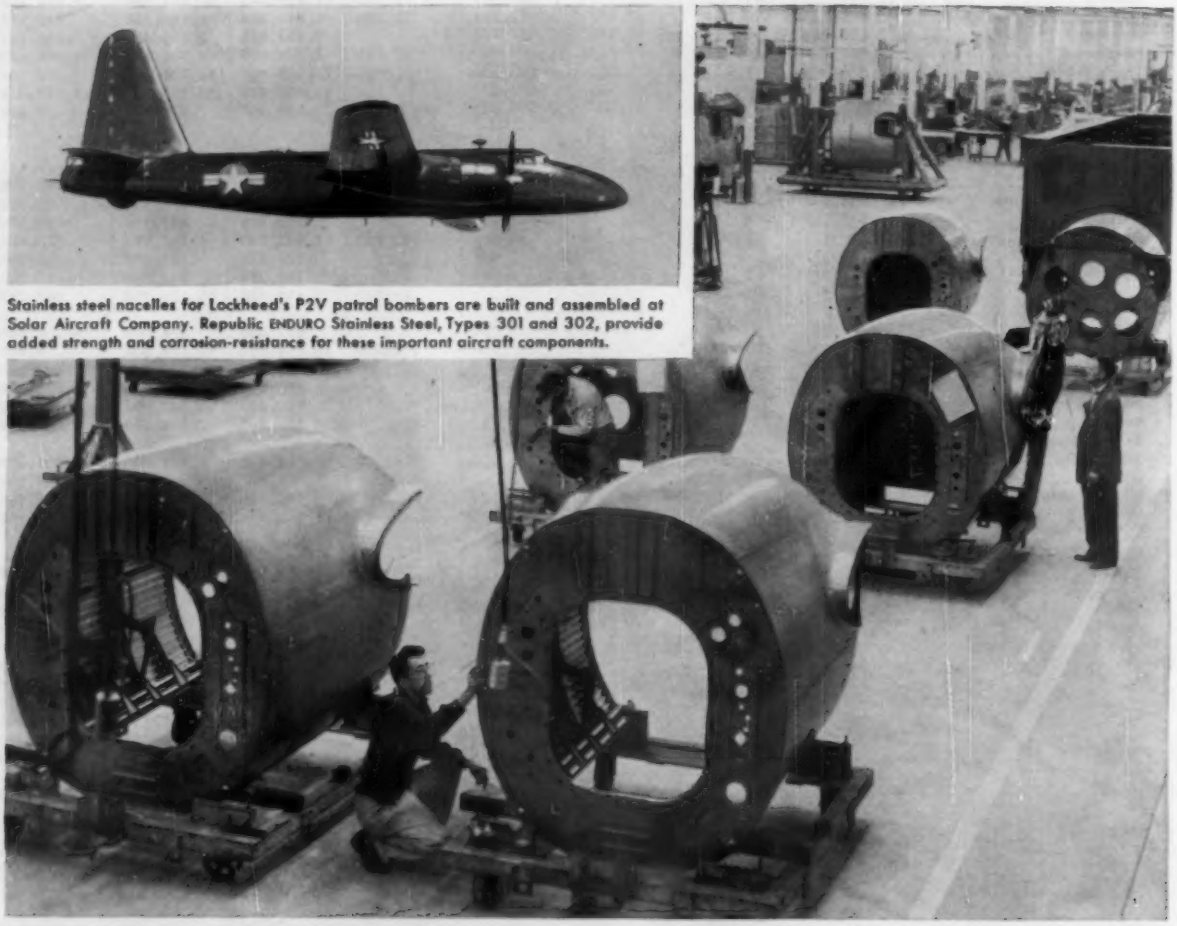
Stainless steel nacelles for Lockheed's P2V patrol bombers are built and assembled at Solar Aircraft Company. Republic ENDURO Stainless Steel, Types 301 and 302, provide added strength and corrosion-resistance for these important aircraft components.



REPUBLIC ENDURO® STAINLESS STEEL HELPS SOLVE strength, heat, and corrosion problems in engine nacelles for the Navy's P2V patrol bombers.

Complete nacelles are built by Solar Aircraft Company, San Diego, California, pioneers in stainless steel airframe construction. To date, Solar has manufactured more than 1000 nacelles for Lockheed's P2V program using A.I.S.I. Types 301 and 302 Stainless Steel.

The stainless steel construction of these airframe units offers a number of advantages including greater strength, ability to withstand high temperatures, less maintenance for protection against corrosion and more economical production processes.

Republic ENDURO Stainless Steels, Types 301 and 302, provide needed strength, yet permit the use of lighter gages to save weight. They are highly resistant to atmospheric corrosion, erosion, and oxidation at high temperatures. They are readily formed into desired shapes by the usual commercial methods.

Like Solar, Republic is also a stainless steel pioneer. Republic metallurgists and engineers pioneered the development of these high strength-to-weight, heat-resistant, and corrosion-resistant metals. To help you use them to best advantage, Republic offers you the services of its famed 3-Dimension Metallurgical teams —field, mill, and laboratory metallurgists. The coupon is your invitation to use this confidential and obligation-free service.

Military Studies Rocket Test Chamber

By Michael Yaffee

Cambridge, Mass.—National Research Corp. has completed a major design study on a 200-ft. long, high altitude, rocket engine test chamber and has incorporated the results in a formal proposal, which now is being evaluated by a major military missile agency.

Unlike present static space chambers, the National Research unit will be pumped down during firings to maintain vacuum and "hold altitude," thereby enabling scientists to study engine operation and combustion under circumstances more closely akin to actual operating conditions. Currently, space chambers maintain vacuum only until the moment of firing when the rocket releases its combustion products gases, raising the pressure and lowering the simulated altitude.

Areas of Interest

With the new facility, which will reach a pre-firing vacuum of 10^{-6} mm. of mercury, propulsion researchers will be able to run a number of experiments, the results of which now can only be guessed. Among the many areas of interest are the following:

• **Better understanding** of high altitude ignition. The failure of second and third stages to ignite at the proper time or at all has been the downfall of many multi-staged vehicles. Explorer II gave a recent and dramatic demonstration of ignition failure when it missed going into orbit. This already is a top priority research program.

• **Optimum propellants** and propulsion methods. The best propulsion system for the first stage could be far from the most efficient for the third stage. Later on, when ion engines and similar systems reach the test phase, their extremely low thrust probably will prove almost impossible to measure accurately in any test unit except a high vacuum chamber. Even with conventional chemical rockets there is no way of really knowing whether or not a new engine will operate at high altitude without either firing it (and trusting to telemetering to report what happens) or testing it in a high vacuum unit.

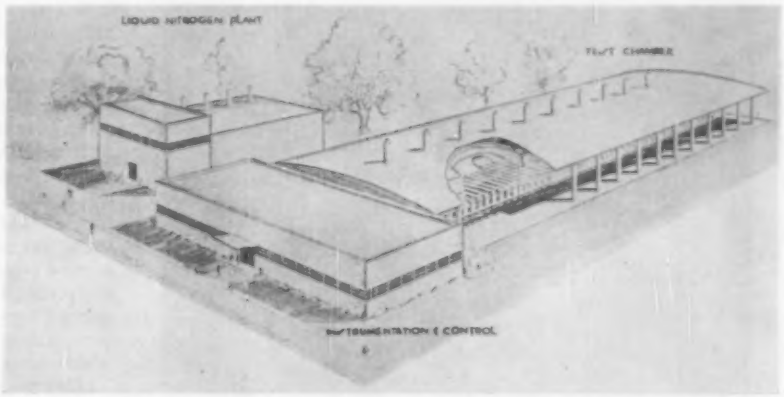
• **Improved nozzle designs.** There is a limit to what engineers can do with theory, for example, in determining the best angle for the diffuser section of a high altitude rocket nozzle or in understanding the aerodynamics of the boundary layer inside the diffuser section.

• **More knowledge of high altitude** combustion and flame characteristics. Burning in vacuo is different from combustion in air. In some high altitude flights, it is believed that some burning actually took place outside the combustion chamber, wasting energy and propellant.

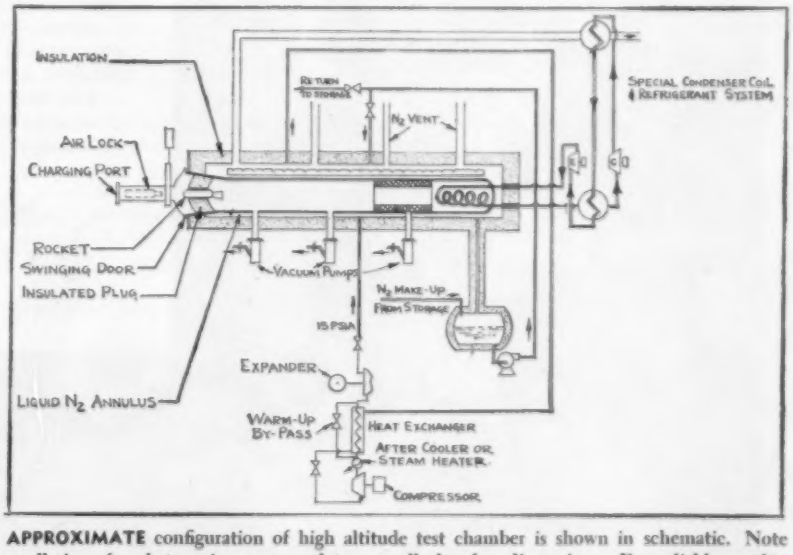
There also are problems in flame stabilization. When the flame shoots out the nozzle—with little or no air pressure to confine it to the familiar, long, cigar-like jet—it may spread out and engulf the entire tail, burning away control surfaces and causing radiation problems. Conventional combustion chamber shapes are already in process of changing, but it will take repeated testing in a dynamic, high vacuum unit to tell the scientists precisely the best design.

There are, of course, many high altitude problems whose solutions will require equipment significantly more sophisticated than that proposed, as well as many "solutions" which will have to be "resolved" for higher altitudes at higher vacuums.

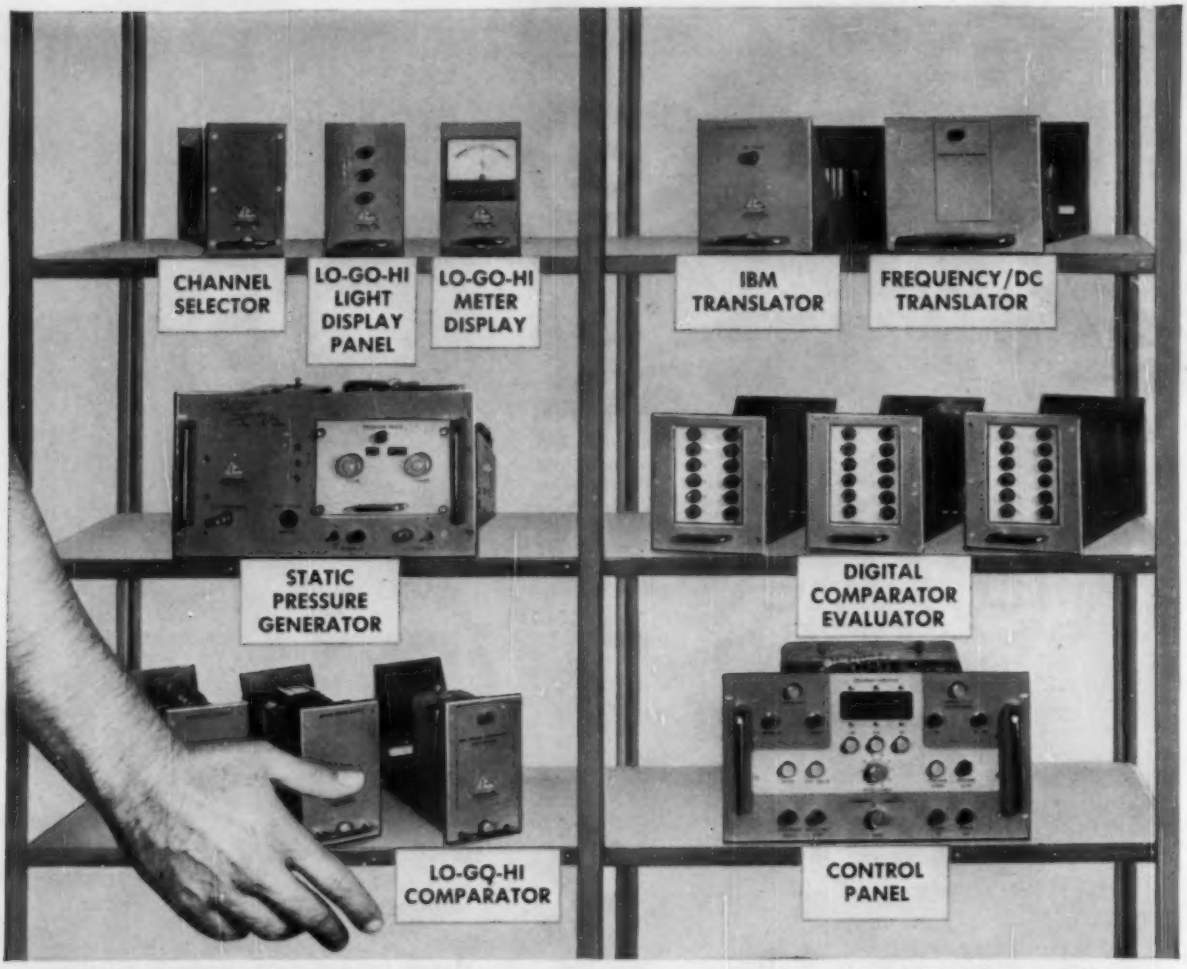
According to Litton Industries' Siegfried Hansen, most space is occupied by a high vacuum, ranging from about 10^{-11} mm. Hg in interplanetary space near the earth, to 10^{-16} mm. Hg in intergalactic space. But the difference be-



HIGH ALTITUDE, rocket engine test facility will have liquid nitrogen plant (left) and administration and control rooms (front). Cutaway gives some idea of large number of pumps required. Roof stacks are nitrogen vents.



APPROXIMATE configuration of high altitude test chamber is shown in schematic. Note small size of rocket engine compared to over-all chamber dimensions. For reliable results, it is important that walls don't interfere with jet exhaust.



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tween certain pressure effects at 10^{-6} mm. Hg and 10^{-11} is not too great, says National Research Vice President Frederick H. Greene, Jr. If the scientists can produce, for example, a flame pattern that is narrow at 10^{-6}, it will be close to the same configuration at 10^{-11}. And, looking at it another way: If an engine won't work at 10^{-6}, it is a pretty safe bet that it won't work at 10^{-11}.

Nevertheless, National Research is already at work on the problem of producing a vacuum test chamber that will go down to 10^{-11} or 10^{-12} M Hg. Present plans call simply for a static unit with a remote possibility for a dynamic chamber of this pressure later. (Litton has a large static test chamber which can be exhausted down to 10^{-6} mm. Hg and the company sees a good chance of producing pumps with speeds of 100,000 to 1,000,000 liters per second and having ultimate pressures 10 or 100 times lower than present pumps.) As with the presently proposed facility, it will be a case of scaling up an existing, small research unit (made, incidentally, of glass) to the size and of the strength required. It can be done with present knowledge, the company says, but the cost will be high.

Beyond 10^{-12} mm. Hg, the technical problems get very involved for the high vacuum scientists. It is at this point that helium and hydrogen start diffusing through the solid walls of the vacuum chamber, raising the pressures. But for the present at least, National Research engineers aren't worrying about the high vacuum problems beyond 10^{-11} in connection with rocket engine testing. (Other work the company is doing, however, such as materials research, does reach down below this point). The primary application for such test chambers, they believe, is on ballistic missiles, which still operate comfortably within the technological limitations of available or attainable high vacuum equipment.

Even a dynamic space chamber with a 10^{-6} capability, such as the one proposed, will move high altitude rocket research a big step forward, they declare, and is almost guaranteed a small but ready market.

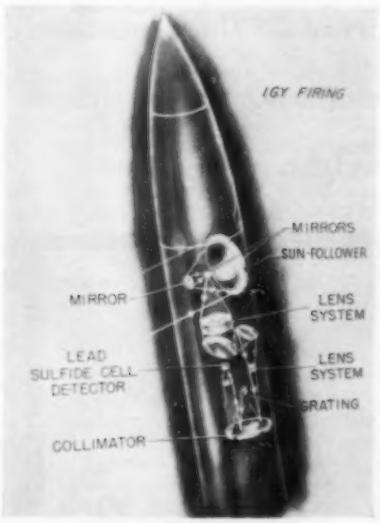
In talking to propulsion experts, National Research discovered that many of them were dissatisfied with the limits of present simulation equipment. Actual rocket flights, their only alternative, were a very expensive research tool and still are far from a satisfactory one. National Research found what was wanted in a high altitude, rocket test chamber; pared these requirements to meet cost and technological considerations, and came up with a proposal for a space chamber that will meet the following specifications:

- **Initial pressures** will range from 10^{-5} to 10^{-6} mm. Hg (equivalent roughly, to 100 mi. altitude). Pressures during firing may be somewhat higher, depending upon percentage of non-condensible combustion gases and other factors.
- **Chamber is designed** to handle solid and liquid propellants of molecular weights between 18 and 28, having heats of combustion up to 25,000 Btu/lb and with burning temperatures from 2300 to 2500K issuing from the rocket.
- **Burning rate** will be at least 200 lb. of propellant per hour of a propellant producing combustion gases of which 50% are non-condensible at −120F.
- **Burning time will** range from fraction of a second to 5 or 10 min.
- **To avoid necessity** for repeated pump-down cycles every time a new rocket is inserted, unit will have a small air lock with a separate pumping system.

Stainless Steel Use

The test chamber itself will be 200 ft. long, 12 ft. in diameter, and will be made of austenitic stainless steel which is non-magnetic and highly corrosion resistant. It will be fully instrumented, heavily insulated, and housed in its own building. Smaller buildings for housing the liquid nitrogen plant, instrumentation and control rooms, and offices will align the main building.

Of its new pumping units, National



Rocket Hygrometer

Humidity in the upper atmosphere will be measured by novel hygrometer installed in nose of Nike-Cajun high altitude carrier rocket for IGY program. Hygrometer uses lead sulphide photocell to measure intensity of sunlight which is inversely proportional to amount of water vapor in the atmosphere between instrument and the sun. Optical system is automatically stabilized with respect to sun, regardless of rocket's pitch, yaw or spinning motion.

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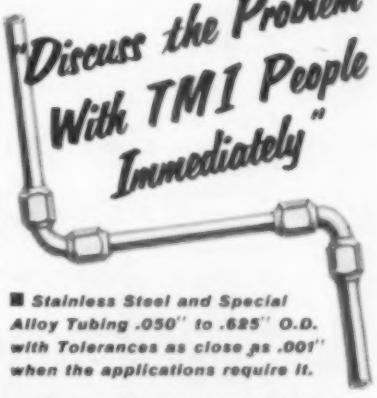

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North American Aviation, Inc.

Research says only that they can move more gases faster. Roughly, this is how the proposed facility will work:

The rocket engine will be placed in the test chamber, which will be closed and evacuated with conventional mechanical and diffusion high vacuum pumps. Hot air will be circulated through the chamber jacket during this time in order to facilitate outgassing (i.e. removal of gas molecules trapped in solid materials).

Most of the sensible heat in the system will be removed by first compressing the air and then passing it through an expander. Liquid nitrogen will then be pumped into the space surrounding the test chamber for the final cooling down.

In the proposed system, the use of liquid nitrogen (which liquefies at −312F) serves a dual purpose: it simulates the temperature found in space, and it acts as an additional pump, helping to remove residual gases and combustion products which condense at liquid nitrogen temperatures.

During the rocket firing, the condensibles will be pumped using liquid nitrogen and cryogenic pumping technique and the non-condensibles will be removed by diffusion and mechanical pumps. A special condenser coil and refrigeration system probably will be placed in the test chamber at the opposite end from the rocket engine to reduce the buildup of non-condensible combustion products at this spot, expected as a result of the jet exhaust action.

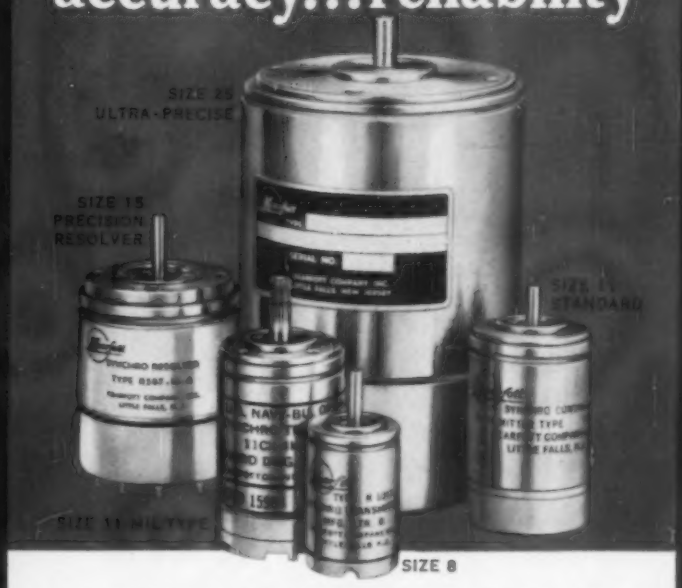
Construction of the facility will take 30 months from the date of a contract, according to National Research, and will be carried out in three phases. First, the company will design, build and operate a pilot plant to verify theoretical conclusions and to gain additional data. Information gained here will be used as the basis for the final design.

Next, the company will prepare detailed specifications and final drawings and will solicit bids from potential subcontractors. The final phase will be construction of the full scale facility.

Preliminary estimates indicate that the total cost of the test facility may run as high as $6 million. But the company doesn't believe price will prove a major deterrent to those who can use a facility such as this. Where the cost might be too high for one agency or company, the individual groups could get together and underwrite the venture jointly. A short time ago, according to National Research, the chamber could not have been built at any price. Large, high vacuum, static test chambers, of course, have been available for some time. But it was only within the past year or two, the company explained, that its researchers were able to scale up the laboratory techniques.

Synchros...another Kearfott capability

accuracy...reliability



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Kearfott offers the widest range of synchros in the industry. Ruggedly constructed of corrosion-resistant materials, they give unequalled performance under every environmental condition. For best characteristics and reliability, specify Kearfott for all your synchro requirements. Here are a few typical models:

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Size 15 Precision Resolver (R587): With compensating network and transistorized booster amplifier, provides 1:1 transformation ratio, 0° phase shift. Max. error from EZ: 5 minutes.

Size 25 Ultra-Precise: 2.478" x 3.187". 45 oz. Available as transmitter, differential, and control transformer. Max. error from EZ: 20 seconds arc.

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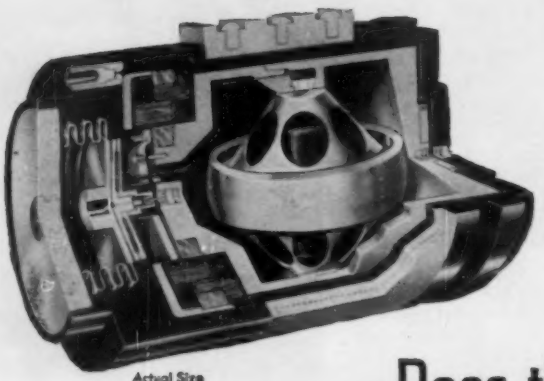

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Does the job of gyros 12 times heavier—new 8-oz. Honeywell MIG (miniature integrating gyro).

With a maximum drift rate of only one-half degree per hour or less and a random drift uncertainty of .05°/hr.—even after subjection to severe environments—the MIG's performance equals that of hermetic integrating gyros many times its size and weight.

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Weight—0.55 lb.

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Running Power—2.5 watts spin motor, 25 watts heater.

Angular Momentum—100,000 gm-cm2/sec.

For further information write: Honeywell Aero Division, Dept. AW-8-11, 2600 Ridgway Road, Minneapolis 13, Minnesota.

Photo shows MIG Gyro with companion unit, GG56 Pendulous Accelerometer (left). GG56 has threshold of 1×10^{-5}g. and linearity of better than 0.1% up to ± 10 g.

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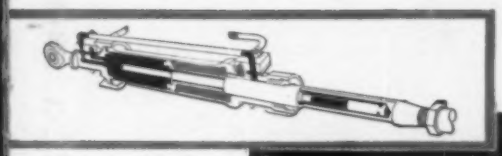
An Aeroproducts full-feathering four-bladed turbine provides all the power needed for pumps and reels in the self-contained "Buddy Store" that turns fighters or attack bombers into aerial tankers in split seconds. This first successful ram air-powered tanker kit is lighter and more streamlined—needs no plumbing or power from the tanker plane.

Little things that mean a lot to Jet-Age Progress

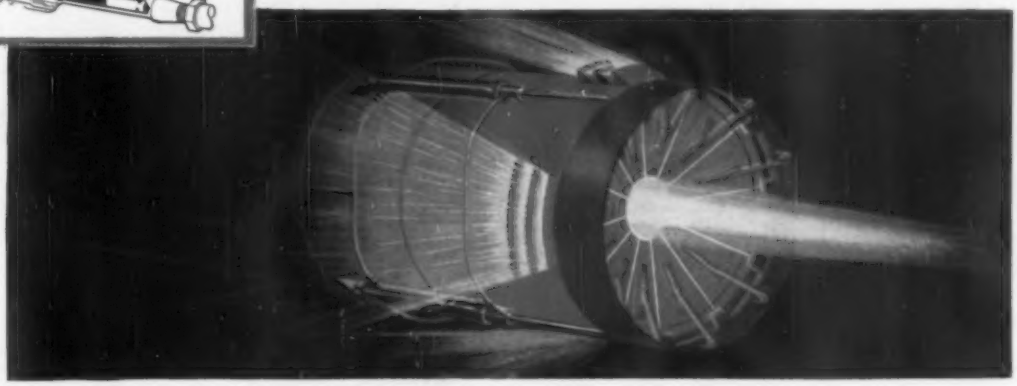
BEATS THE ICE BARRIER

New Aeroproducts ICEFOIL is specially designed for installation in gas turbine intake duct—activates de-icing systems at speeds from 50 to 500 knots—meets requirements of MIL-D-8181 plus 2000 cps @ 15G Vibration Test *plus* 1450 ft.-lb. Ice-ball Impact Test. In extensive wind tunnel tests, the ice/de-ice cycle time varied only 3%.

COOL PERFORMER FOR HOT JOBS



Proved in severe tests from ambient to 1000°F, the new Aeroproducts high-temperatures linear hydraulic actuator makes dependable operation of thrust spoilers and thrust reversers possible. Now being supplied to Marquardt Aircraft Company for incorporation in a complete reverser system, its patented fluid flow and seal system removes heat rapidly and continuously—provides positive seal—assures smooth, dependable operation. Patented synchronization system permits multipoint installation. If required, a patented self-locking feature automatically holds reverser or spoiler in fixed position if power fails.



The four examples shown here – each tops in its field – are only a part of the Aeroproducts story. Aeroproducts proved design ingenuity and production know-how are now speeding the solution to many "sticky" airborne accessory problems on commercial and military aircraft and on missiles and rockets. Aeroproducts engineers are ready today to consult on your projects – classified or unclassified. Write:

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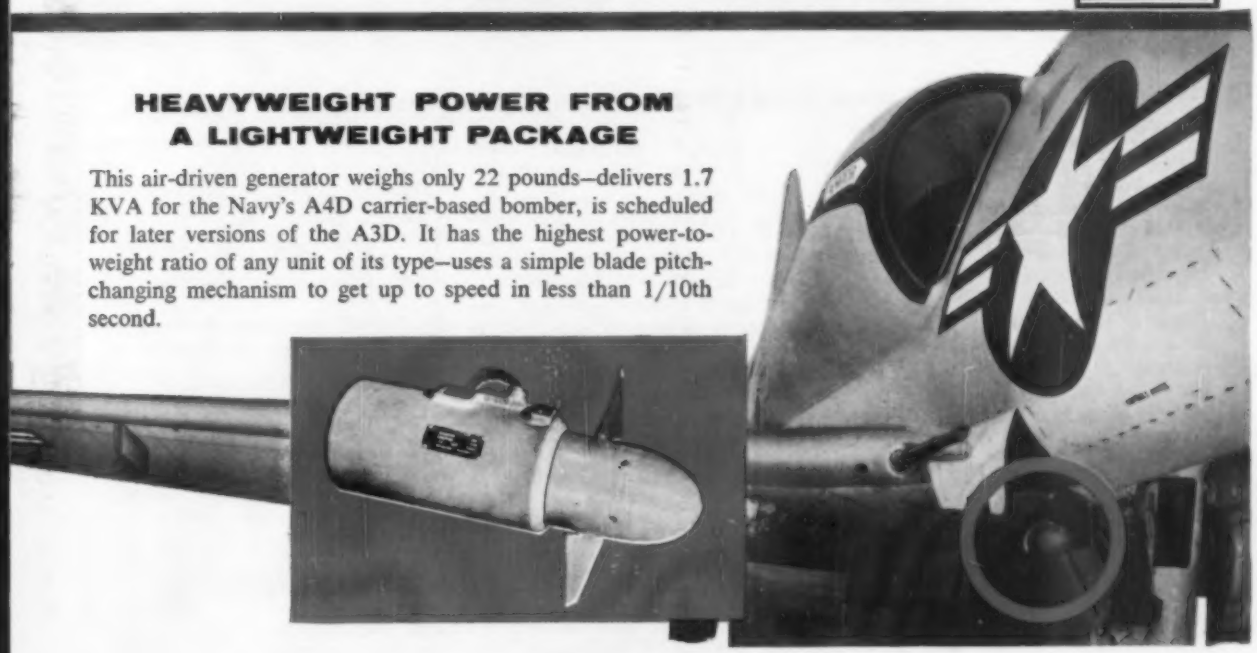
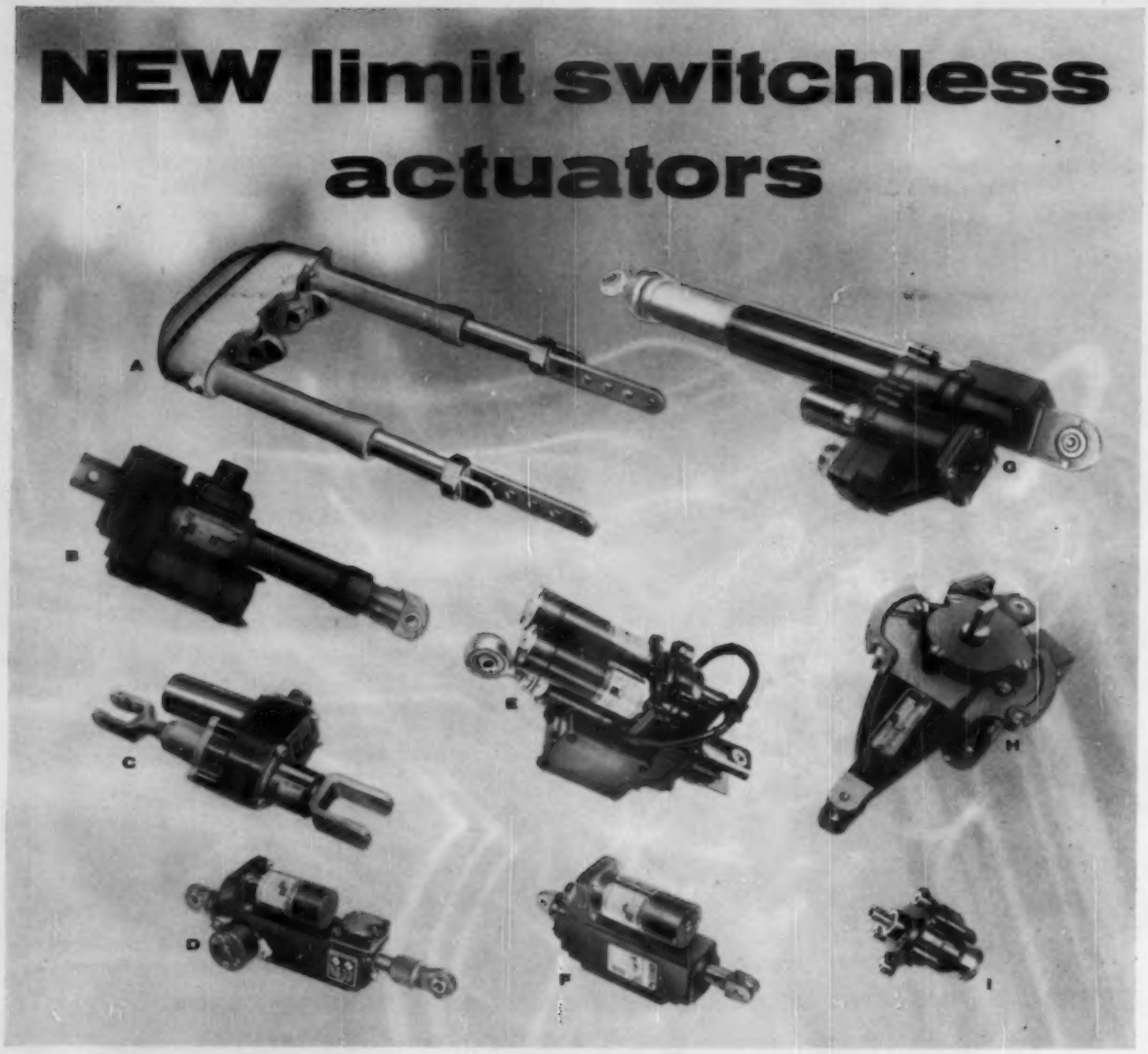
This air-driven generator weighs only 22 pounds—delivers 1.7 KVA for the Navy's A4D carrier-based bomber, is scheduled for later versions of the A3D. It has the highest power-to-weight ratio of any unit of its type—uses a simple blade pitch-changing mechanism to get up to speed in less than 1/10th second.



NEW limit switchless actuators



Reduce weight and cost 25% below conventional design

A reduction in actuator cost and weight up to 25 per cent, with similar maintenance savings, has been achieved through the advance design of AiResearch electromechanical Limit Switchless Actuators for aircraft and missiles.

Elimination of limit switches in power actuators is a result of AiResearch development of superior high temperature motors and resilient non-jamming positive stops.

Limit switches are eliminated by two methods: 1) use of continuous stall high temperature motors, 2) use of high temperature motors with thermal protectors which permit maximum *on* time in the duty cycle.

Additional advantages of AiResearch Limit Switchless Actuators: they are smaller, less complex and the possibility of limit switch failure is eliminated.

Development of Limit Switchless Actuators reflects AiResearch experience in producing more than a million rotary and linear units. Current production includes several hundred actuator types, many with high temperature applications.

Your inquiries are invited.

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- **E** *2-Motor Trim Actuator, REPUBLIC F-105*
- **F** *General Purpose Linear Actuator*
- **G** *Dual Purpose Feel Trim Actuator, AVRO CF-105*
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Ground Testing May Ease Space Problems

By Richard Sweeney

Los Angeles—Human factors problems of man in space are not all discovered by engineers and scientists as they advance in space technology, some come from such mundane sources as letters from people interested in space technology.

In relating this incident of how a problem was brought to the attention of medical investigators, Dr. Marvin Whitlock of Convair told a session of the National Summer Meeting of the Institute of Aeronautical Sciences here that the problem raised by the letter writer was the relationship of the earth's electromagnetic field to the functions of the human body, a circumstance taken for granted which may require quite a bit of physiological and psychological adjustment on the part of space crews.

Many problems of humans in space remain unsolved and new problems are constantly being discovered, Dr. Whitlock said, adding that ground testing can materially aid in solving known problems and discovering new ones.

Space Voyage Problems

Dr. Whitlock's paper dealt with data on man's metabolism and the problems which may arise from it on long term space voyages, such as growth of hair, fingernails, skin desquamation, differentials in intake and output of the human system; and ground testing for manned space flight.

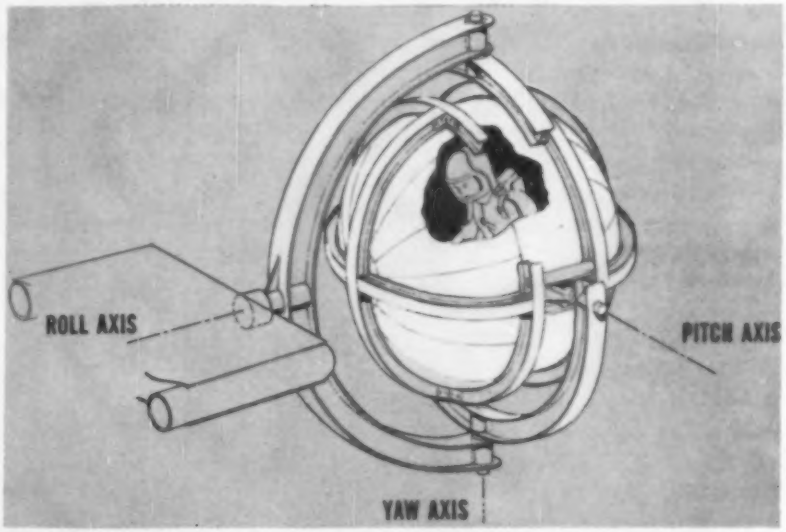
Sealed cabin required to support man above 70,000 ft. was termed by Dr. Whitlock as a Life Support System (LSS) and that the only alternative is stored gas-controlled leakage system such as is used in today's airplanes. Only true sealed cabin, Whitlock says, is that at USAF's School of Aviation Medicine, and Convair's Astronautics Division wishes to proceed to a lightweight, compact, flight worthy article.

Convair feels, he indicated, the man and his entire Life Support System should pass through the combined stresses of flight while on the ground, as part of flight worthiness evaluation. He added that a proper omni-environmental test facility can simulate all but two features of space flight—weightlessness and ionizing radiation.

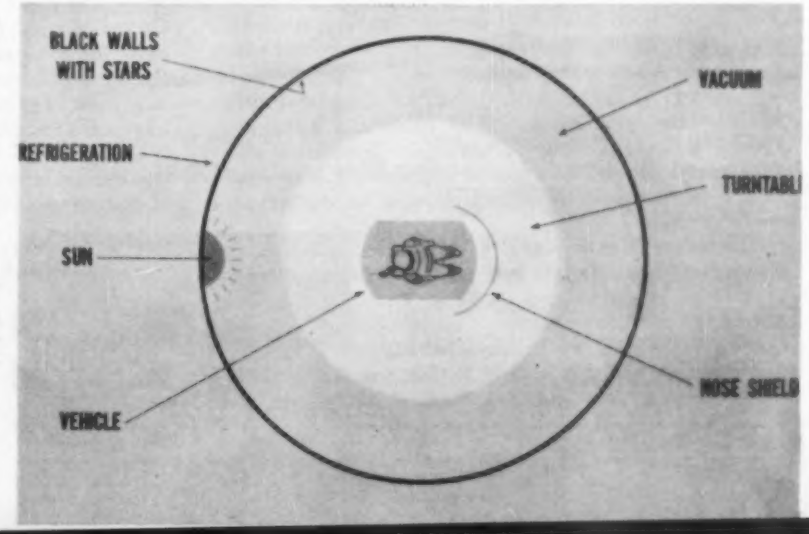
Facilities would include the USAF-owned centrifuge at Convair's Astronautics plant, and a space chamber beside the centrifuge. These would simulate launch and re-entry and orbit or free space flight except for the weightlessness and ionizing radiation.

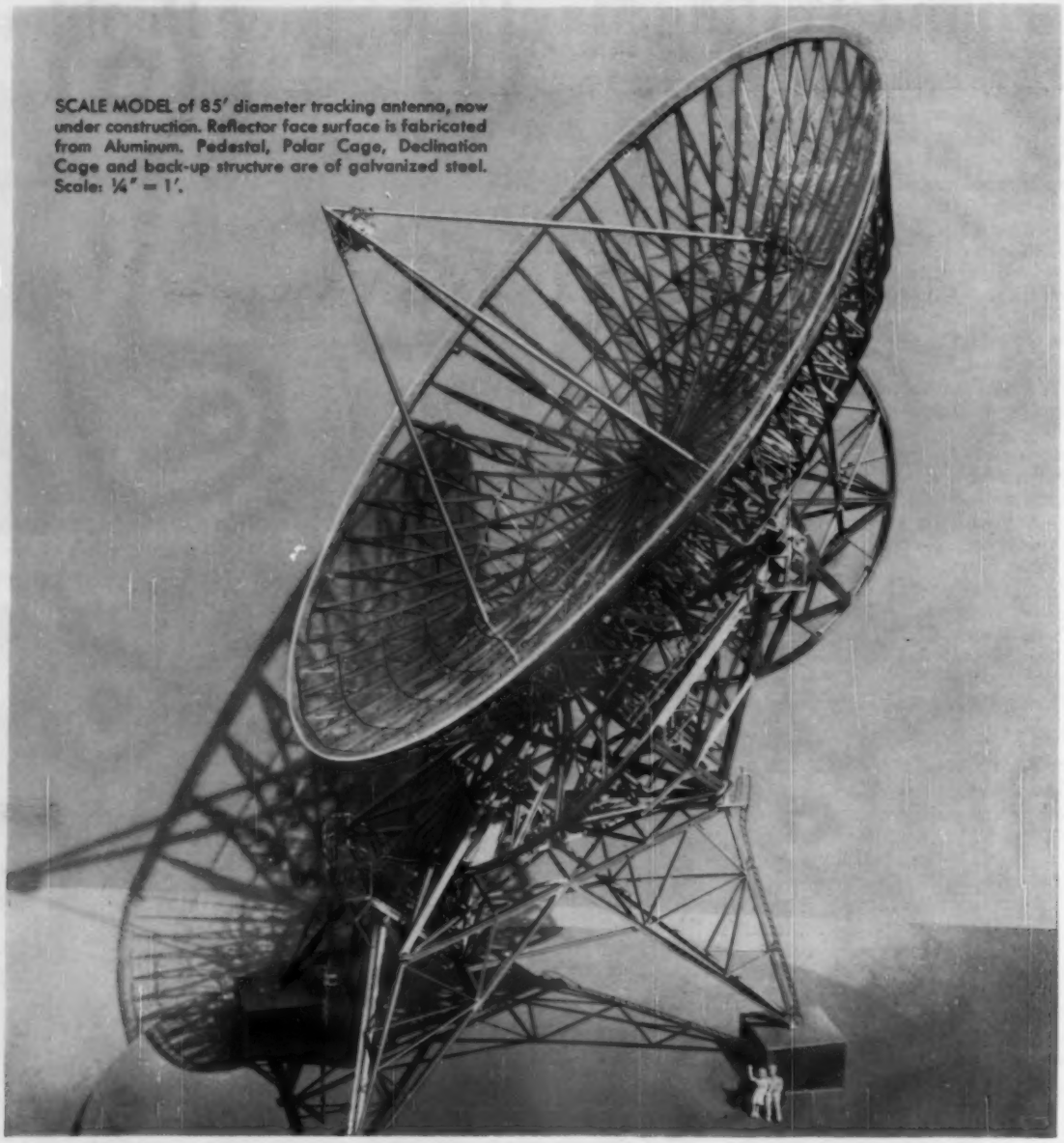
Stresses encountered by sealed cabin,

ACCELERATION of 100Gs can be reached on USAF-owned centrifuge at Convair Astronautics Div., San Diego, Calif. Equipment pod (foreground) can carry ton of materials.



CENTRIFUGE cabin mounted on three axes free gimbals (above), vibrator, tape recording, heating elements, vacuum lines and pumps could simulate stresses encountered by man during launch and re-entry. Vertical projection (below) is of Convair's proposed space chamber containing one-man vehicle.





SCALE MODEL of 85′ diameter tracking antenna, now under construction. Reflector face surface is fabricated from Aluminum. Pedestal, Polar Cage, Declination Cage and back-up structure are of galvanized steel. Scale: ¼″ = 1′.

New Blaw-Knox 85′ Diameter Tracking Antenna

This newest Blaw-Knox 85′ Diameter Tracking Antenna will be part of a telemetering operation connected with missile and satellite development.

Its design is fully determinate. All structural members of the assembly are analyzed for stress and deflection before fabrication. Coupled with shop fabrication and field erection to rigidly accurate tolerances, it is capable of the highest gain, with a minimum of distortions or aberrations.

The entire drive system embodies such critical design requirements as infinitely variable movement with negligible creep or overrun for tracking. The slewing drives are capable of the extremely rapid acceleration and deceleration necessary to focus on supersonic targets.

Pioneering like this is the latest step in a long series of Blaw-Knox developments. Such milestones as the Guyed Vertical Radiator design in AM radio, the first radar antenna used to bounce signals off the moon, and the Tropospheric Scatter Antenna for over-the-horizon television have marked Blaw-Knox as a world leader in advanced design, fabrication and erection techniques.

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man and subsystems would include, during launch and re-entry—acceleration, oscillation, spinning or tumbling, vibration, noise, heat and hypobaria; these would be simulated with centrifuge, cabin on three free axes gimbals, a vibrator under the seat, tape recording, heating elements in cabin walls, and vacuum lines and pumps.

Orbit of free space stresses except the weightlessness and ionizing radiation, would include heat, cold, rotation, hypobaria, darkness, confinement and low sensory inputs, infinite heat sink, solar radiation—which could be simulated by an artificial "sun" and air-conditioner—turntable, vacuum pump and lines, opaque, insulated and refrigerated blackened walls. Some separate simulation of weightlessness may be obtained by water submersion as has been done in tests already.

Equipments required to simulate the environmental conditions could be installed in and around the small sealed chamber, at particular locations on the wall of the centrifuge where they would accurately reproduce the desired effects such as "sun." Locating the "space chamber" nearby would permit swift transition of the sealed cabin to the space chamber without interruption of testing except to connect and disconnect plugs and lines, leaving subject still in sealed cabin.

As principles for and utility of ground testing, Dr. Whitlock said Astronautics has evolved the following:

- **Precedes and augments flight** testing, with safety and economy.
- **Includes combined environmental** stresses to be encountered.
- **Tests the integrated system.**
- **Long term utility** of facilities is enhanced by modulation of equipments and use in selection and training of space crews.

Five principles evolved for flight testing, Dr. Whitlock declared are:

- **Instrumented and animal** flights precede man.
- **Man is essentially** out of the control loop in first flights.
- **Thorough prior ground testing.**
- **Augmentation by flight testing.**
- **Probing the unknown in increments.**

Sperry Manufactures Jupiter Guidance

Inertial guidance for Army's Jupiter intermediate range ballistic missile is being produced by Sperry Gyroscope as well as by its sister Sperry Rand Division, Ford Instrument. Sperry Gyro, which is producing about one-third of the units, reports that after five months under contract it is "ahead of schedule," has delivered 80% of its initial commitment, has remaining 20% in test.

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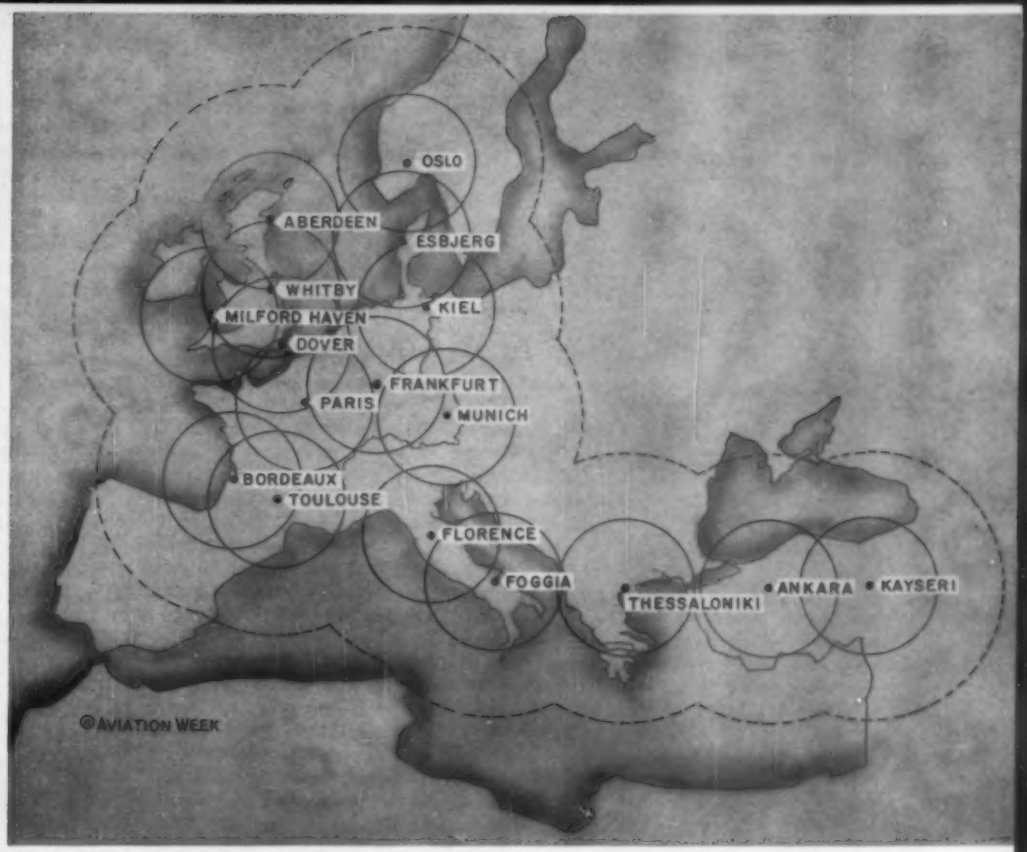


TEST Bomarc is launched at left. Boeing map at right shows proposal for Bomarc bases near principal cities in European area.

Nations as Area Defense Weapon System

over the entire flight path required to make the missile highly maneuverable on a combination of lift and thrust.

So Bomarc evolved as a miniature airplane, launched by a rocket engine and powered in cruise flight by a pair of ramjets. Like an airplane, it banks in turning flight, instead of skidding as do most maneuvering supersonic missiles.

Currently there are two different Bomarcs under active development:

• **Bomarc IM-99A,** the first production missile, with an operational radius of 200 mi. The launcher is an Aerojet-General liquid propellant rocket and the sustainer is a pair of Marquardt RJ43-MA-3 ramjets. Design speed is about Mach 2.5 at a cruise altitude about 60,000 ft.

• **Super Bomarc IM-99B** is an advanced version with an operational radius of better than 400 mi. Launcher is a Thiokol solid-propellant rocket and the sustainer is a pair of improved Marquardt RJ43-MA-7 ramjets similar to those of IM-99A. Design speed has been estimated at close to Mach 4 at altitudes around 100,000 ft.

Both missiles would be almost identical in external appearance and their ground environment and support equipment would be almost completely common to both. Super Bomarcs could therefore be delivered to Bomarc bases and with a minimum effort effective coverage of a base would be quadrupled in area.

Research Program

Boeing also has a major missile research program under way in an anti-missile application, but this is not to be confused with a stretched Bomarc or as an extension of Bomarc techniques. Complexity of the problem and technological advances in the next few years will dictate a completely different approach.

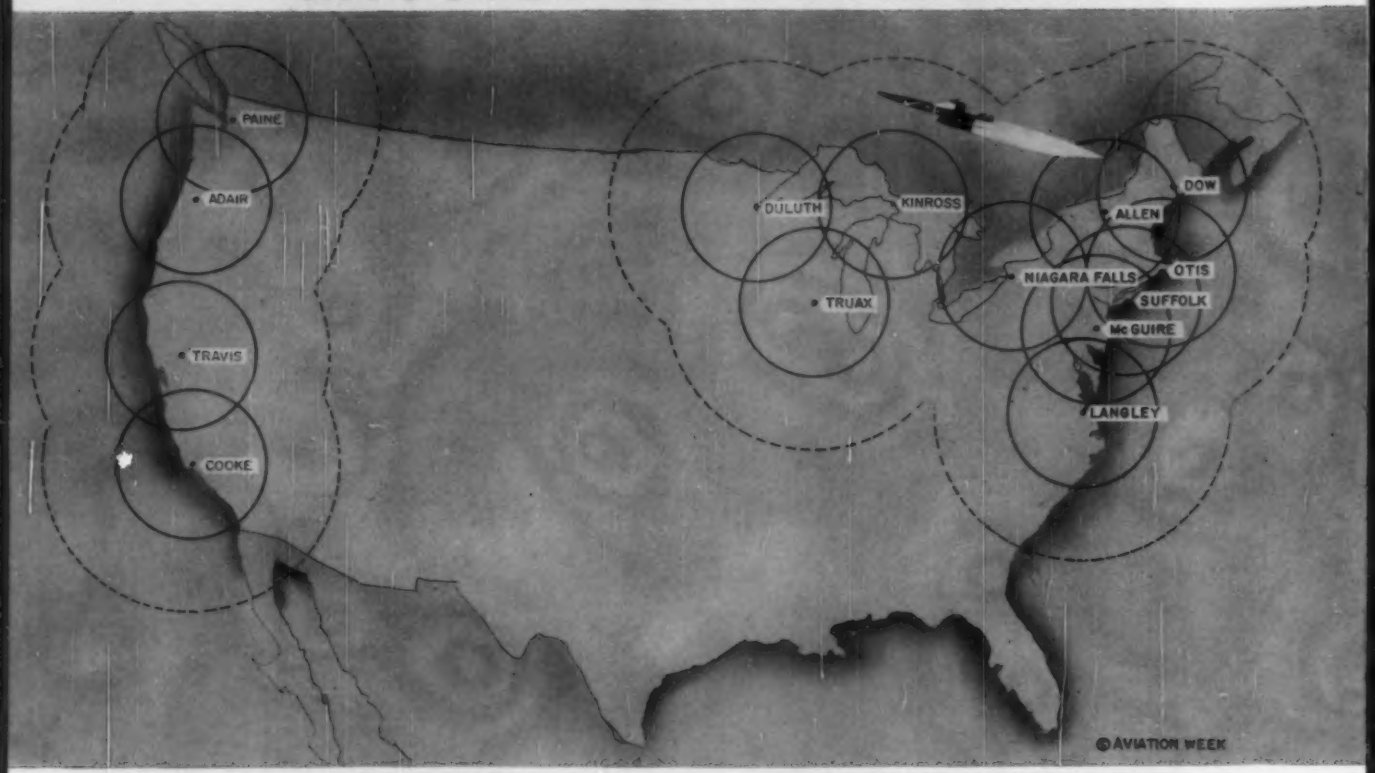
Boeing has a solid argument behind its sales pitch: selection of Bomarc as the area-defense missile for the North American continent. Fourteen Bomarc bases have been officially announced by USAF, with construction beginning on four located on the East Coast between Maine and New Jersey. About $168 million has been approved for base construction.

As prime contractor for the entire missile system, including specialized ground environment and support equipment, Boeing is responsible for over-all design of Bomarc defensive scheme. The company holds announced contracts for several hundred million dollars for production rounds and associated ground support equipment.

USAF has activated the first Bomarc squadron cadre in 4751st Air Defense Missile Wing, 73rd Air Division, Tyndall AFB, Fla. Officers from the wing are now completing a maintenance engineering course at Boeing, will shortly transfer to firing site at Air Force Missile Test Center, Cape Canaveral. Next assignment will take them to an operational training base now being built on Santa Rosa Island in the Gulf near Eglin AFB, Fla. Final assignment will be at a completed Bomarc site at one of the bases now under construction.

The Key structures on a Bomarc site are missile shelters, one for each of 24 rounds, and reinforced concrete buildings split on a vertical plane through building centerline. These shelters receive the missile after its final off-site assembly and readying and from then on store the bird in a state of readiness.

Each base is linked through communications network to weapon control center. There multiple display panels



MAP shows where 14 Boeing Bomarc area defense missile weapon system sites are located in 12 states in the United States.

Boeing Proposes Bomarc Missile to NATO

By David A. Anderton

Geneva—Boeing Airplane Co. is making a strong bid to sell its Bomarc area-defense weapon system to European countries within the NATO framework.

Military teams from France, Germany and Sweden have already been briefed completely on the missile at Boeing's pilotless aircraft division in Seattle. Unclassified presentations of system capabilities are being made at various levels of the NATO structure.

Company is specifically selling its improved Bomarc IM-99B or Super Bomarc, designed to strike targets at least 400 mi. from its base. Current production Bomarcs were designed for a 200-mi. operational radius.

Boeing's 15 Super Bomarc batteries located behind the curving NATO perimeter could provide area defense for the entire sweep of countries from Norway to Italy and from West Germany to Portugal. Such a system would be tied in to an early warning net now being built and use the Westinghouse AN/GPA-35 weapons control. Bomarcs entering service with USAF's Air Defense Command will be linked into the SAGE ground environment system.

Company concentrates on selling Bomarc as the most defense for the least money. Boeing points out that it does not eliminate the need for point defense missile systems such as the Nike Ajax units now being built in Germany, Belgium and the Netherlands. But Boeing emphasizes that individual Bomarc rounds cost a fraction of the money needed for a Century-series fighter, that site and personnel requirements are at a minimum.

Bomarc's Advantages

Four major advantages are claimed for the supersonic ramjet-powered Bomarc:

- **Maximum firepower,** which means that any number of rounds up to an entire squadron of 24 Bomarcs can be launched against mass attack. Firings can be sequenced or in salvo, singly or in groups. As an extreme case, all 15 batteries could salvo their entire complement and get 360 missiles in the air at once.
- **High traffic capacity,** which Boeing says is unique among current defensive missiles. Westinghouse weapon control system is planned to handle multiple intercepts simultaneously. Ground computers can work parallel intercept problems, feed data to a number of airborne missiles either by frequency-division or time-division data link.
- **Lethality,** which is provided by the nuclear capability of the missile. Bomarcs can carry either conventional high explosive or nuclear warheads depending on expected threat.
- **Flexibility,** which provides operational capability including single isolated intercepts of enemy intruders or reconnaissance flights, multiple and separate intercepts against either dispersed raid or raids from several headings, and multiple kills resulting from single nuclear detonation in the middle of a massed enemy raid.

Basic concept of Bomarc led to the selection of its unusual layout with a composite powerplant of rocket booster and ramjet sustainers. Original requirements were for a long-range interception missile, which dictated two things: economical supersonic cruise and ability to maneuver at supersonic speeds without an appreciable velocity energy loss. Ramjet powerplants could provide the cruise performance needed and at the same time, supply continuous thrust

of Bomarc weapon system. But the Air Force has said that one Bomarc round intercepted a target drone in a head-on collision, an angle where there is generally the least reflected radar energy.

Most of the layout of Bomarc is perfectly obvious from pictures. Wingspan of chopped delta planform is 18 ft. 2 in. Over-all length is 47 ft. 4 in. measured between fuselage base not including thrust chamber protrusion and theoretical nose tip just ahead of actual blunted surface. Maximum height is 10 ft. 3 in. and width of horizontal tail surfaces is 10 ft. 6 in.

Main body shell of Bomarc is about 33 in. dia. and an external spine on top of fuselage carries plumbing and wiring outside the circular outlines of the fuel tanks. Forward ogival nose section is glass fiber housing for missile's active homing system.

Aerodynamic Layout

Aerodynamic configuration of Bomarc is sophisticated resulting from extensive studies of complex shock patterns around missile and inlets to ramjet engines. Manual effect of engine and airframe shock systems must have proven a tough nut for Boeing project aerothermodynamicists to crack but a glimpse at the earliest form of Bomarc shows they were aware of the problem from the start and designed the layout right the first time.

Somebody once casually suggested, at an evaluation of the Bomarc missile, that its two ramjet engines might usefully be replaced by one, solving duplication problems of lines, fittings and fabrication. Quick estimate of the trouble involved in reworking aerodynamics of the configuration alone reached tens of millions of dollars and killed the suggested revision quickly.

Bomarc uses wingtip ailerons for roll control and banking turns. Surfaces are pivoted on a spanwise line rather than on usual chordwise location. Elevators and rudder are similar, providing Bomarc with all-movable control surfaces of high effectiveness at supersonic speeds. Layout of controls was perfected on Project GAPA, Boeing's first missile program. Outboard trailing edges of control surfaces are blunt. Gross weight of Bomarc is about 15,000 lb.

Bomarc has built-in launching rocket plus two sustaining ramjet engines for major portion of missile's flight.

In current production of IM-99A rounds, booster is liquid-propellant rocket unit made by Aerojet-General Corp. Thrust chamber of booster is gimbal-mounted for flight-path control during boost phase. Fuel is mixture of JP-4 and UDMH (unsymmetrical dimethyl hydrazine); oxidizer is RFNA (red fuming nitric acid). Burning time for boost phase is on order of 45 sec.

Sustainer powerplants for IM-99A are paired Marquardt RJ43-MA-3 ramjets, 28 in. dia. and weighing just under 500 lb. complete (AW Apr. 30, 1956, p. 48). Design speed is Mach 2.5, where engine produces equivalent of 50,000 hp. Corresponding sea-level static thrust would be about 10,000 lb.

Ramjet has a 50-deg. central spike to force a single inclined shock focused on a sharp-edged cowling. Fuel for these units is H-octane gasoline. These engines powered experimental Bomarc rounds as well as current production run, and were also flown on the Lockheed X-7 test vehicle.

One unusual feature of ramjet powerplants is that they are lit off in remarkably low subsonic speed and altitude during boost phase of flight. Thrust build-up follows rapidly as the bow shock is formed and nears the cowl lip, finally to impinge on it to maintain maximum diffuser efficiency, and therefore maximum thrust.

For the Super Bomarc with its increased range and performance, liquid-propellant rocket booster will be replaced by solid-fuel unit manufactured by Thiokol Chemical Corp. The ramjet engines for advanced missile will be basically improved Marquardt units designated RJ43-MA-7. Recent flights with this engine on Lockheed X-7 test vehicle have produced data points at

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give controllers in the center visual indication of the status of every individual missile in the area under control. Series of red, yellow and green lights in groups of 24, each group representing a complete missile flight of 24 rounds, shows instant status and enables battery commander to select and fire rounds ready to go.

Inside shelter, each Bomarc rests in horizontal position on its launcher. When alert is sounded to activate battery, shelter opens in response to sequenced signals, splitting on vertical plane. Form above shelter resembles a letter V.

Ready to fire, Bomarc is elevated to verticle attitude. When firing switch is pushed by battery commander, rocket engine is ignited, flares from ramjet ignition are lit, erector arm falls away and Bomarc is free to rise.

Entire procedure is completed in less than two minutes after alert signal, ". . . While the pilots are still being driven to their interceptors," as a Boeing representative said.

Bomarc blasts off launcher in vertical position with liquid-propellant booster at full thrust and ramjet engines spewing smoke from the ignition flares. Within a few seconds after takeoff, the ramjets ignite and for the second phase of boost add their increasing thrust to constant thrust of rocket.

Missile flight path initially is straight up, and then Bomarc goes into quarter-loop, coming out of the inverted position after a half-roll, headed for the general direction of target. Presumably this odd flight path prevents fuel starvation of engines since fuel pumps would be working against high G loading in pushover trajectory.

Design speed conditions for ramjets are Mach 2.5 and 60,000 ft. Points are probably held closely by missile fuel system because of relative sensitivity of ramjet engine to its design envelope.

From this altitude, Bomarc can attack conventional aircraft about its own level, dive to pick up low-level intruder, or use kinetic energy in zoom climb that will carry it well above 100,000 ft. to meet a detectable future threat such as extremely high-altitude air-breathing missile. Super Bomarc, with speeds on the order of Mach 4, would have more than two and one-half times the kinetic energy of Bomarc, and would already be at altitude approximating 100,000 ft. Zoom climb performance would take it well beyond atmosphere.

The operational radius of Bomarc of about 200 mi. is sufficient to hit enemy bombers using air-to-surface missiles before they get to release point. Super Bomarcs are expected to more than double this operational range, so that they can strike targets about 400 mi. distant. Corresponding enemy range capability could be that of a composite bomber with missile.

Bomarc intelligence starts with ground radar environment, and goes through AN/GPA-35 weapons control system which uses computers to tell missile where to head during initial flight phase. Continuous computation of predicted target path and Bomarc trajectory feeds additional data to missile in middle of trajectory.

When Bomarc is within active seeking range, its own internal guidance system cuts in, searches and locks on target. From then on, missile is completely unresponsive to signals from ground and homes into target.

Accuracy of guidance is one of secrets

Principal Nike Zeus Contractors

Major contractors in the Army's Nike Zeus anti-ballistic missile program include the following:

PRIME CONTRACTOR: Western Electric Co. Bell Telephone Laboratories is responsible for program development.

AIRFRAME & RELATED EQUIPMENT:

- Douglas Aircraft Co., Santa Monica: Development of missile and associated equipment.
- Battelle Memorial Institute, Columbus, Ohio: High temperature materials development—metal diffusion.
- Aerophysics Development Corp., Santa Barbara, Calif.: Hypersonic test vehicle.
- California Institute of Technology, Pasadena: Wind tunnel tests.
- Cornell Aeronautical Laboratory, Buffalo: Wind tunnel tests.
- National Research Corp., Cambridge, Mass.: High temperature alloy research for structure.
- NACA, Langley Field, Va.: Four-inch Aeroder tests.
- Ohio State University Research Foundation, Columbus, Ohio: Wind tunnel tests.
- Special Effects Mfg. Co., San Fernando, Calif.: Explosive separation devices.
- Stanford Research Institute, Memlo Park, Calif.: High temperature resin development.
- University of California at Los Angeles: High temperature problems in boundary layer.

PROPULSION:

- Grand Central Rocket Co., Mentone, Calif.: Sustainer and vectoring motor development.
- Gladden Products, Glendale, Calif.: Experimental nozzle fabrication.
- Thiokol Chemical Co., Huntsville, Ala.: Booster motor development.

AVIONICS-GUIDANCE:

- Western Electric, Winston-Salem & Burlington, N. C.: Construction of ground guidance equipment.
- Radio Corp. of America, Moorestown, N. J.: Acquisition radar transmitter development.
- Sperry Gyroscope Co., Great Neck, N. Y.: Target track transmitter development.
- Goodyear Aircraft Corp., Akron, Ohio: Acquisition transmitter-receiver antennas.
- Ryan Aeronautical Co., San Diego: Missile-borne seeker.
- Lear, Inc., Grand Rapids, Mich.: Stable platform.
- Wheeler Laboratories, Inc., Great Neck, N. Y.: Antenna and feedhorn design.
- Microwave Development Labs, Wellesley, Mass.: Development of high power rotary joints.
- Allis-Chalmers Mfg. Co., Milwaukee: Target track antenna drives.
- Continental Can Co., Inc., Chicago: Target track antenna mount.
- Narmco Mfg. Co., LaMesa, Calif.: Target track antenna.
- McMillan Industrial Corp., Ipswick, Mass.: Molded Insulation Products, Philadelphia; Robinson Industries, Muskegon, Mich.; Perry Plastics Inc., Erie Pa.; Plastic Film Products, Inc., Akron: Koppers Co., Monaco, Pa.: Development of foam support for artificial dielectric.
- Armstrong Cork Co., Lancaster, Pa.: Development of artificial dielectric.
- Dow Chemical Co., Midland, Mich.: Acquisition receiver antenna dielectric.
- Microwave Radiation Co., Gardena, Calif.: Telemetry antenna.
- Era Engineering, Inc., Santa Monica, Calif.: Development of material erosion indicator.
- Firestone Tire & Rubber Co., Los Angeles: Instrument environmental tests.
- Coors Porcelain Co., Golden, Colo.: Seeker radome development.
- Passon Industries, Inc., Painesville, Ohio; Anco Label & Tape Co., Inc., Freeport, N. Y.: Experimental printed dipoles.
- Ambassador Plastics, Inc., Chicago: Artificial dielectric production equipment.

GROUND FACILITIES ARCHITECT:

- Burns & Roe, Inc., New York City.

Mach 3.95 at altitudes above 100,000 ft. This kind of performance indicates the substitution of a continuous compression diffuser inlet for the single inclined shock type used on RJ43-MA-3 engines. Marquardt is working on ramjet engines with such an inlet.

There is also the possibility that Super Bomarc will have "zip" fuels for its ramjet engines.

Along with development and production of the Bomarc, Boeing has intensive parallel work in flight testing and training.

Flight tests of IM-99A Bomarc should be completed by now at the Air Force Missile Test Center. Future firings of production rounds now being delivered will be the responsibility of a USAF operational training unit to be stationed at Santa Rosa Island. Since September, 1952, when the first Bomarc prototype vehicle lifted off its stand to mark the beginning of flight tests, Boeing has launched 39 complete missiles. Last rounds in program were complete with all operational equipment. Next phase of Bomarc work at Cape Canaveral will be firings of Super Bomarc IM-99B. Program is expected to cover up to 40 rounds and to take several years to complete.

Guidance system flight tests began on converted Martin B-57 modified by Temco Aircraft Corp. to take the first 17 ft. of the Bomarc nose and fuselage. This long-nosed B-57 was used to run intercepts on a Lockheed T-33 manned target to check operation and accuracy of Bomarc's homing system.

Now being completed at Harbor Island near Seattle is the simulated Bomarc base to be used for factory training of Air Force missile technicians. Operating for last two years as a training school, Harbor Island was remodeled along the lines of a condensed Bomarc base, including near-prototype shelter. Only difference is that the Harbor Island shelter has a tall steeple to allow Bomarc to be raised to firing position without need to open roof and expose students and instructors to Washington weather.

Bomarc History

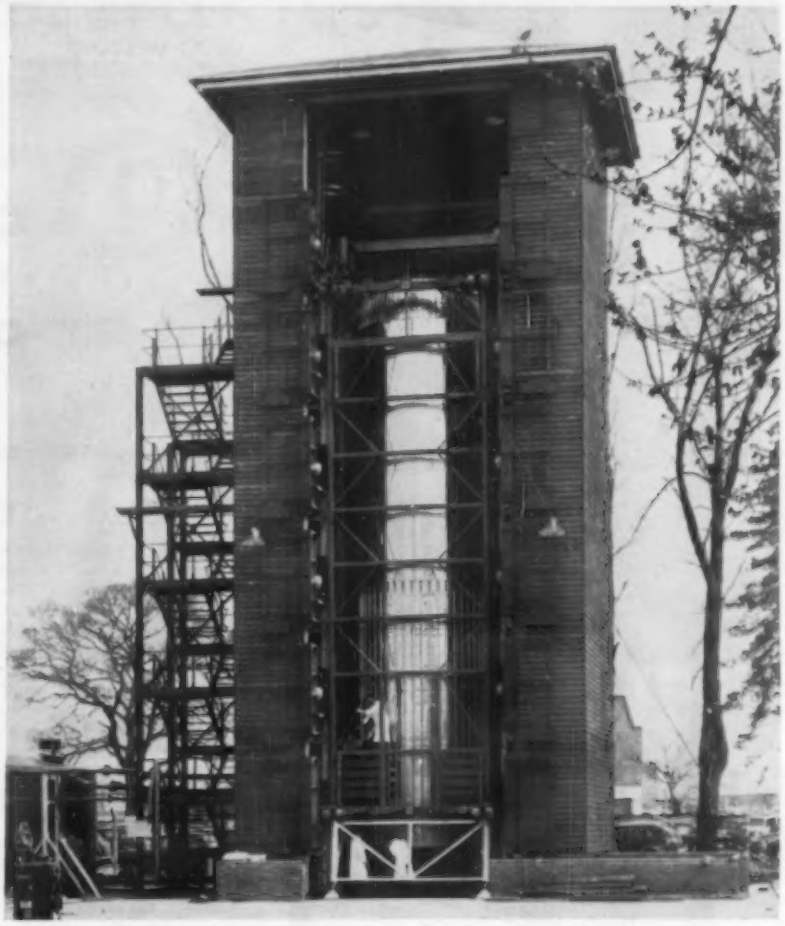
Boeing started work on anti-aircraft missiles with its GAPA—ground to air pilotless aircraft—program at the end of the war. Project entered phase two program in January, 1946, with funding to cover building experimental flight test vehicles and construct ramjet engine. First firings followed immediately and before termination of program in 1949, Boeing test crews had launched 112 vehicles of all shapes and sizes.

GAPA was canceled on a bleak day in 1949; the news was announced during a meeting in Seattle of the Bumblebee Project launching panel. Decision arose out of the feud between Air Force and Army over anti-aircraft missiles. GAPA was short-range weapon and under terms of agreement hammered out in 1949, Army Ordnance got responsibility for such missiles.

With GAPA dead, Boeing quickly proposed to Air Force an advanced weapon with increased range and complex ground support system. USAF in turn passed them along to the University of Michigan where an air defense system called Wizard was being studied at the time. New project became a joint effort, with the name Bomarc taking its first two letters from Boeing and the last four from Michigan Aeronautical Research Center.

The first prototype Bomarc vehicle without its ramjet engines flew Sept. 10, 1952. It resembled greatly the last vehicles in GAPA program. First ramjet powered Bomarc flew successfully Feb. 24, 1955.

The first production IM-99A round was delivered to USAF last Dec. 30 and subsequent production rounds are following in rapid buildup. Work of Pilotless Aircraft Division is being relocated in missile production center in Seattle and shift will be completed by January. Peak employment of 8,000 persons is expected by mid-1960 on Bomarc program.



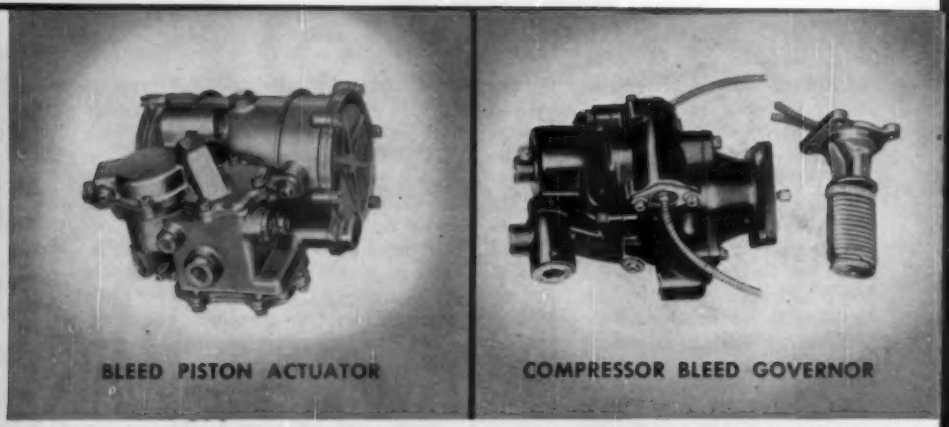
British Start Long Range Missile Tests

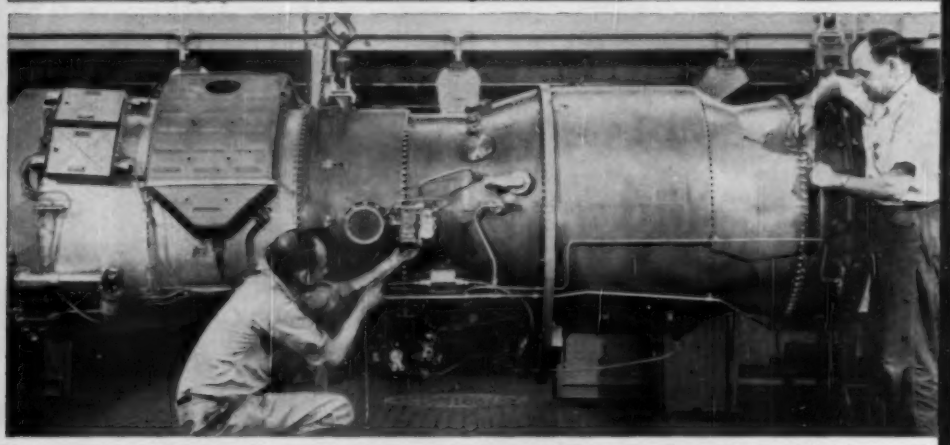
Testing of systems and components of British long range ballistic missile is under way at Hatfield, England. Missile will carry nuclear warhead, is 10 ft. in diameter and is about 70 ft. long. Rocket motor tests will be undertaken at Spadeadam Waste, Cumberland; firing trials at Woomera, Australia. De Havilland Propellers, Ltd., is prime contractor.

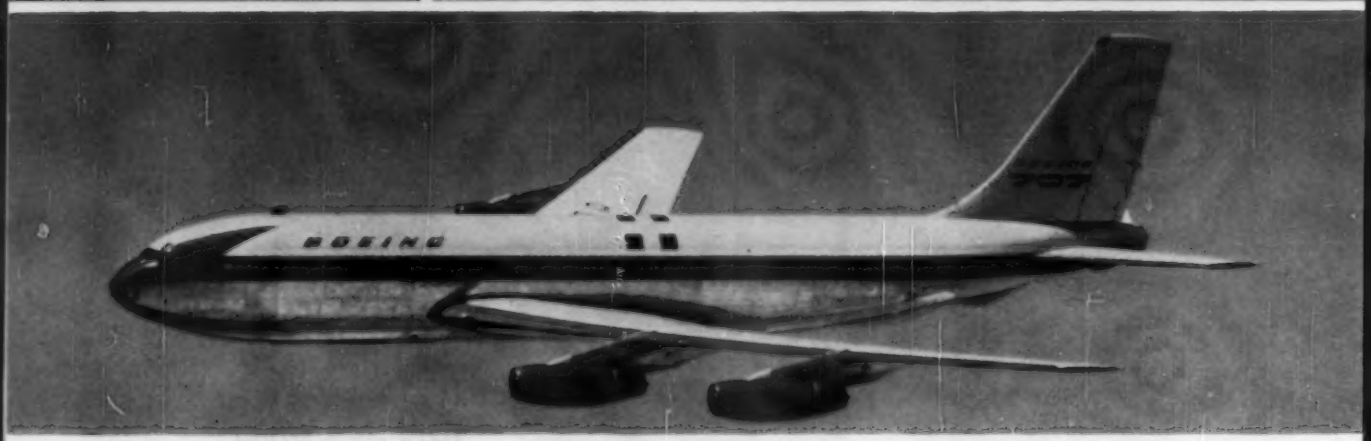
Diversey Engineering Buys Huntsville Plant

Diversey Engineering Co., Franklin Park, Ill., guided missile component manufacturer, has purchased the plant, equipment and assets of the Warrior Tool & Engineering Co., Huntsville, Ala. Warrior will become the Huntsville Division of Diversey Engineering Co. Division will be expanded into the new Huntsville Industrial Site Area, and an additional 40,000 sq. ft. have been purchased for the expansion.

Holley engine controls selected for JT4 engines on America's first jet airliner

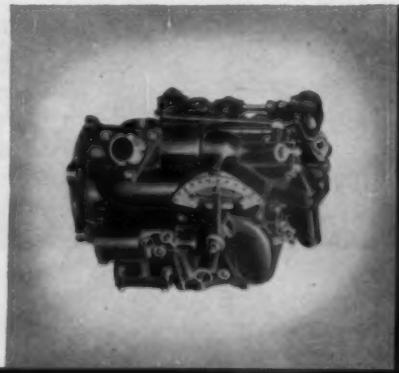






Powered by four JT4 Pratt & Whitney Aircraft engines, the Boeing 707-320 will carry 131 first class passengers from New York non-stop to the Continent in just over six hours! Each of these new engines, commercial counterparts to the J-75 which drives many of America's latest jet fighters, delivers up to 15,000 pounds of thrust. Ability to pack so much added power into a relatively small space is the result of designing engine components which will operate at higher efficiency, require less area and reduce over-all weight.

Holley Carburetor Company, working closely with Pratt & Whitney Aircraft engineers, carried out this exacting assignment on such vital engine components as: the compressor bleed governor, and the bleed governor actuator. For single and multi-engine military aircraft, the Holley main fuel control is a companion unit to the Holley governor and actuator.



For military applications, the Holley main fuel control (right) is a companion unit to the governor and actuator.

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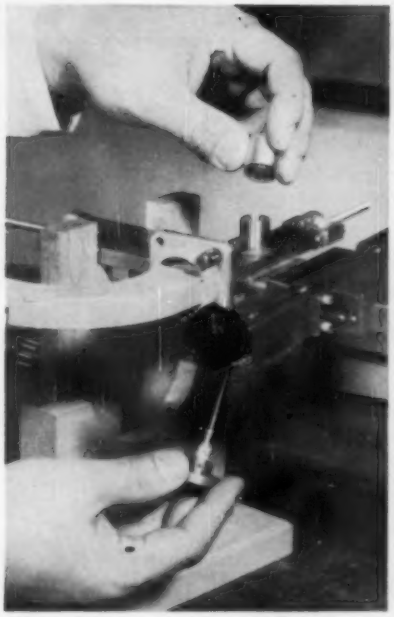

TEST SETUP for studying amplifying properties of a non-linear capacitor semiconductor diode is at left. Special diode and enclosure are being inserted from bottom. Pump frequency of 12,000 mc. enters from left while 6,000 mc. signal frequency enters at right, is amplified and reflected back through same waveguide. UHF traveling wave amplifier employing four special diodes is at right.

Diode Amplifier Has Low Noise Potential

By James A. Fusca

Murray Hill, N. J.—New type of variable reactance amplifier which uses semiconductor diodes as the active elements offers advantages of extremely low noise, simplicity, long life and low cost. Capable of operating over a broad range of frequencies and providing relatively large bandwidths, devices appear to provide significant improvements in applications ranging from commercial television receivers to microwave radars.

Low noise characteristics of the amplifier can be gained at room temperature. No refrigeration or magnetic fields are necessary. Device is under development at the Bell Telephone Laboratories.

As with other types of variable reactance amplifiers, applied voltage is derived from a high frequency pump signal. With this technique, the pump signal voltage is applied to a variable reactance diode (varactor diode) causing it to function as a time-varying capacitance and supplying the energy to produce amplification.

Low Noise Amplifiers

Because the device operates on the principle of varying one parameter of a circuit, it falls in the category of "parametric amplifiers" along with ferromagnetic amplifiers which depend upon varying inductance. A separate but confusingly similar named category is "paramagnetic amplifiers," one form of maser.

Comparison of amplifier characteristics obtained thus far in the development phase with present devices for low noise amplifications indicate the potential usefulness of the Bell technique. At 500 mc. a 416B special triode will provide about 23 db. gain with a bandwidth of 7 mc. and a noise figure of 3.5 db. At this frequency the semiconductor amplifier provides 10 db. gain with a bandwidth of 100 mc. and a noise figure of 3.5 db.

At 5,000 mc. the best traveling wave tubes will provide about 20 db. gain with a bandwidth of 500 mc. and a noise figure of 4.0 db. while the semiconductor amplifier will provide 12 db. gain with a bandwidth of 8 mc. and a noise figure of 5.5 db. for single sideband amplification, 2.5 db. for double sideband.

A related type of parametric amplifier has been announced by Radio Corp. of America (AW July 14, p. 83) which employs a germanium diode and a pump signal but differs in that the pump signal is at a lower frequency than the signal to be amplified; Bell device uses a higher frequency pump signal.

Amplifier consists of the silicon diode mounted in a waveguide or coaxial cavity and is a source for the pump signal. Incoming signal is inserted into the cavity and removed through a circulator which isolates input from output. In the cavity the signal is amplified through mixing with the pump signal as both signals are impressed on the nonlinear capacitive reactance of the diode.

Capacity Effect

Although the variable capacity effect is present in commercial semiconductor diodes, Bell scientists have developed a special diffused silicon diode to maximize the effect. Because series resistance is a potential source of noise, these diodes minimize resistance through a graded diffusion technique. Active diameter is only about 0.002 in.

When the two signals are impressed on the diode, a wide spectrum of modulation products is produced. The two lowest sidebands appear at the sum and difference frequencies of the signals and only these sidebands are of significance.

The amount of gain obtainable is limited only by the properties of the circuit and obeys a constant gain-bandwidth product relation. Gain in this type of device can be considered as a negative resistance effect.

A single diode can be used to provide amplification at any desired frequency from the high microwave region to d.c. Noise performance of this type of ampli-

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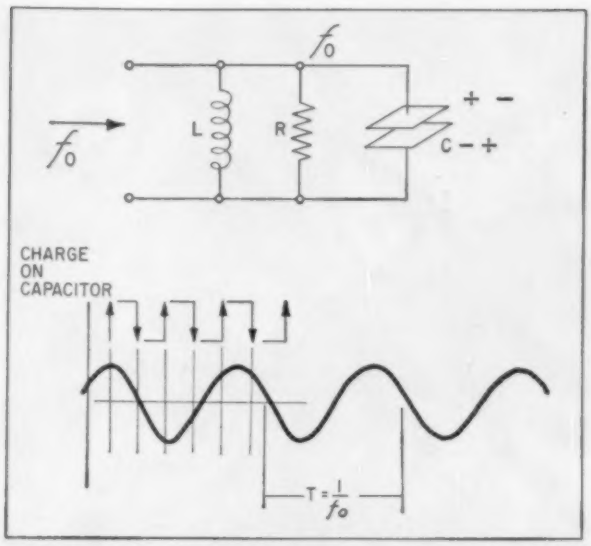
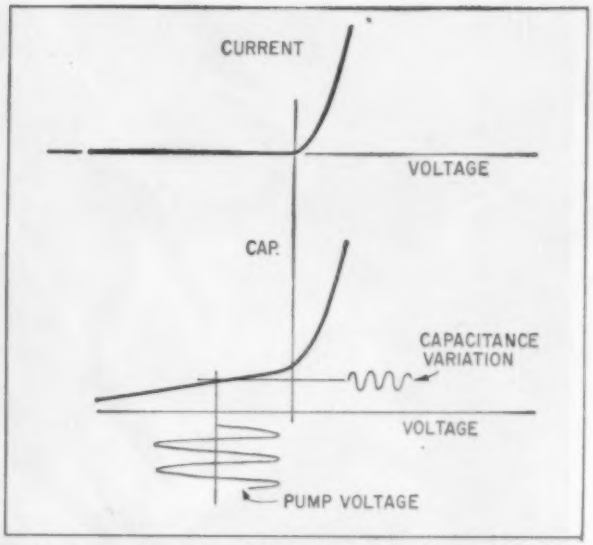




PROCESS OF AMPLIFICATION through interaction of signal and pumping frequencies can be demonstrated by mechanical analogy at left. If a slowly oscillating signal is applied and capacitor plates pulled apart at maximum charge and moved together at minimum charge, mechanical pumping action will cause amplification of the signal. Drawing at right compares current-voltage relationship of conventional p-n diode with capacity-voltage relationship as pumping signal is applied.

fier improves as the frequency decreases into the UHF region.

In a typical amplifier of this type, the semiconductor diode is inserted at the junction of two waveguides. A pump signal of 12,000 mc. is impressed upon the diode through one waveguide while the 6,000 mc. signal is inserted through the other waveguide.

More Signal Power

Amplification is obtained by returning more signal power into the input waveguide than was inserted.

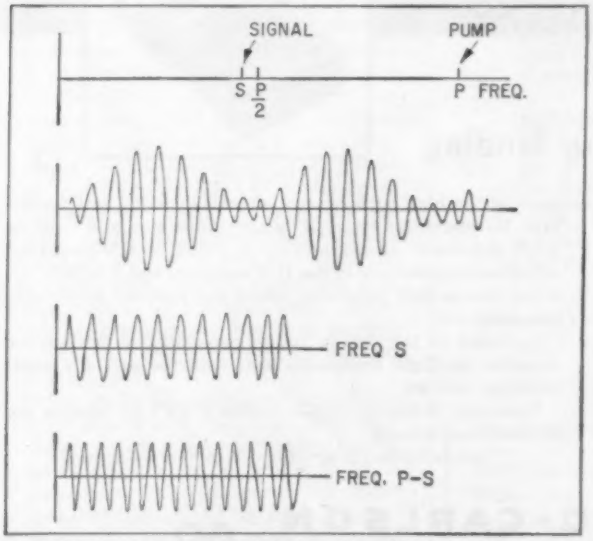
A circulator is used to provide isolation between the incoming and outgoing waves, and to prevent thermal noise in the load from being amplified.

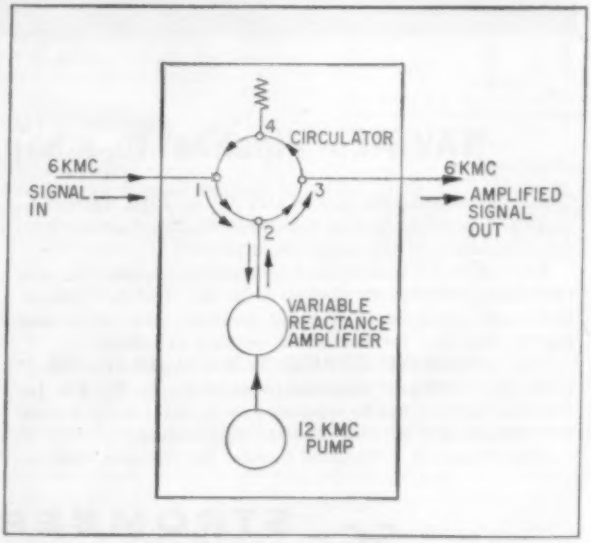
Gain of the amplifier depends on the pumping power level as well as on the circuit adjustment. Requirement for the pumping source is that it produces a suitable voltage swing across the nonlinear capacitance of the diode. Therefore, a diode with a high static capacitance will require more pump power than one with a low value, and a circuit with a high Q for the pump will be more efficient than a low Q circuit.

A traveling wave amplifier configuration, employing arrays of several diodes, has produced bandwidths as wide as 25% of the midband frequency in the UHF region. By using four stages with the special diodes in such an array, Bell scientists have obtained a bandwidth of 100 mc. at a 400 mc. signal frequency, with a pump frequency of 900 mc. and a pump power of 10 mw. Amplifier had a gain of 10 db. and a noise figure of 3.5 db.

Pumping Action

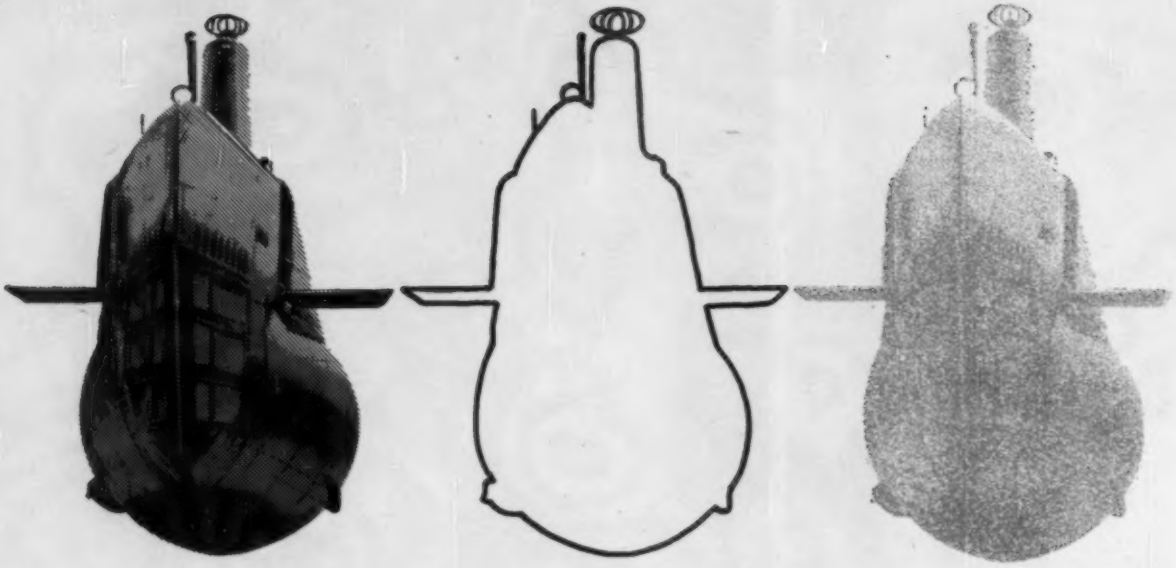
Process of amplification through the interaction of a pumping signal can be compared with the following physical analogy. If a slowly oscillating signal were applied to a simple resonant cir-





DRAWING at left shows modulation of amplified signal output of the variable reactance amplifier that results from interaction of the signal frequency with the idler (difference) frequency. Sketch at right indicates path of the input signal through the circulator used to isolate input from output.

in antisubmarine warfare, it has to be . . .



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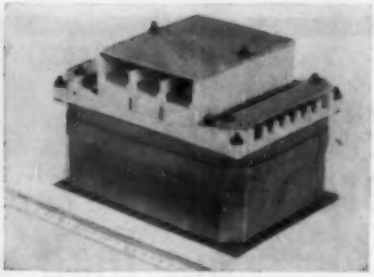

Hot Circuit Breaker

Aircraft circuit breaker designed to operate for 1,000 hr. at temperatures of 600F, is rated 225 amps. at 480 v., three-phase, 400 cps. Interrupting capacity is 4,000 amps., closing time is 0.05 sec. or less, trip time is 0.01 sec. or less. Westinghouse Electric, Aircraft Equipment Dept., Lima, Ohio.

cuit, alternating positive and negative charges would build up on the plates of the capacitor.

If a mechanical pumping action could be applied to the plates of the capacitor in phase with the applied signal—that is, if the plates of the capacitor could be pulled apart quickly at the instant of maximum charge and pushed close together quickly at the instant of zero charge—the mechanical work of pumping would cause the applied signal to be amplified.

Output Power

In the semiconductor amplifier, output power is divided between the amplified signal and the modulation products.

Most important of these products is the difference frequency between the pump and signal frequencies. Because of the power output in this sideband, difference frequency must be selected to be outside of the bandwidth of interest.

Because this difference frequency consumes power without contributing to the operation of the amplifier, it is termed the "idler" frequency. Because of the generation of this and other image frequencies during the process of amplification, noise performance of the amplifier should be better for use with a double sideband centered exactly at one-half the pump signal frequency, with coherent signal and idler frequencies, than with a signal having the same total power but with no symmetry about the one-half pump frequency point.

On an experimental basis, amplifier noise figures as low as 3db. have been obtained with this special kind of double sideband operation, corresponding to a 6 db. noise figure for normal operation. However, because of the noise inserted at the idler frequency, when the equivalent temperature of the input load is decreased, even with ordinary operation the added noise becomes less than that of an ordinary amplifier having a 6 db. noise figure.

Because of the nature of the amplification process, noise appears in the signal frequency band at the output due to:

- **Input noise.** Noise input at the signal frequency is amplified with the signal.
- **Idler noise.** Input noise at the idler frequency can be converted to the signal frequency in the amplification process.
- **Diode noise.** Noise originating in the diode at the signal frequency will be amplified with the signal.
- **Sum frequency noise.** Noise generated in the diode at the sum frequency of the signal and pump frequencies will be converted to the difference frequency in the amplification process.

Most important source of noise in the diode is that originating as thermal noise in the series resistance.

Bell scientists say that there is little doubt that better circuits will be developed which will make use of improved diodes to product amplification with noise figures significantly lower than those obtained to date.

A second area receiving intensive investigation is solid state circuitry to replace conventional microwave pumping frequency generators to achieve an all solid state amplifier.

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No. 9162 Overwing Nozzle

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No. 4092 Underwing Nozzle

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The equipment is designed to meet the rigorous environment of the high-performance aircraft of today and tomorrow. Its operating ambient temperature range is −60 to +125 degrees C. at altitudes up to 70,000 feet. Widespread use of semiconductors in the ILS receivers and TACAN circuitry means high reliability, small size and low power consumption.

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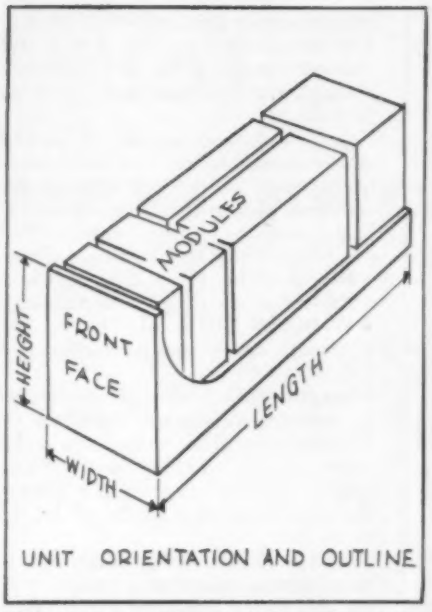
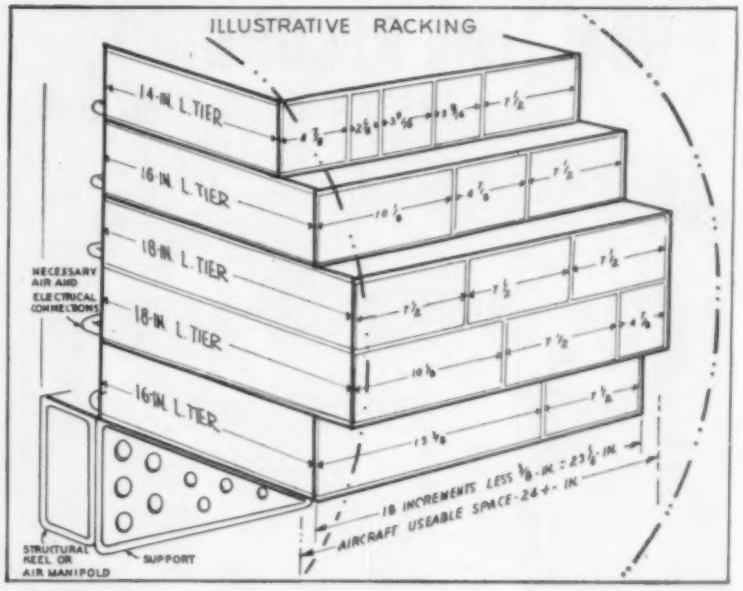




NEW Air Force exhibit standardizes dimensions of modules and chassis on which modules mount for use in future communication, navigation and identification equipment for manned aircraft flying in the 1958-1965 period to provide greater installation flexibility (left). Form-fitting of avionic units to fuselage shape to minimize waste space is envisioned in the Air Force exhibit (right).

USAF Avionics to Use Standard Modules

By Philip J. Klass

Washington—Avionic design criteria for Air Force communication, navigation and identification equipment for use in manned vehicles in the 1958-1965 period have been issued by Wright Air Development Center's Communication and Navigation Laboratory.

New exhibit WCLN-58-18 adopts small modular building-block concept and dimensions developed by Navy Bureau of Aeronautics in its MIL-E-19600 (Aer). This exhibit replaces recently issued MIL-U-25900 (USAF) which was withdrawn when Air Research & Development Command Headquarters decided that further coordination with other ARDC centers and laboratories was needed before design criteria could be issued as an Air Force specification.

New modular concept and dimensions should enable:

- **Air Force** to easily and quickly repackage avionic equipment for use in new airframes without major equipment redesign now required.
- **Aircraft manufacturers** to form fit avionic equipment into airframe configuration with greater efficiency, less waste space.
- **Avionic manufacturers** to use standardized module dimensions for many Air Force and Navy airborne equipments permitting greater interchangeability of Air Force and Navy developments.

Until several years ago, it was possible to use single standardized design of communications, navigation and/or identification equipment on a variety of different aircraft. Today, most avionic equipment must be tailored to the form factor requirements of each individual airplane to use available space effectively.

Runaway Problem

Even in such basic devices as communications sets, common to all Air Force aircraft, the problem has gotten out of hand. For example, despite the fact that the Air Force has three basic UHF communications sets in its inventory (ARC-27, ARC-33, ARC-34), each with a different form factor, none of them were suitable for use in new airframes such as the F-105, B-58 and F-108. As a result, it was necessary to develop or repackage five new UHF sets, each to meet requirements of a different airplane.

This has proven costly in terms of money and engineering time and compounds Air Force logistic support problems, without appreciably improving the state of communications, according to John C. Wightman. (Wightman is chief, integration section, Communication and Navigation Laboratory.)

Through use of new standardized modules, WADC expects to be able to quickly repackage an equipment to achieve almost any desired form factor.

In addition to standardizing module dimensions, new specification also standardizes certain dimensions of the "units" (chassis) on which a group of modules is mounted.

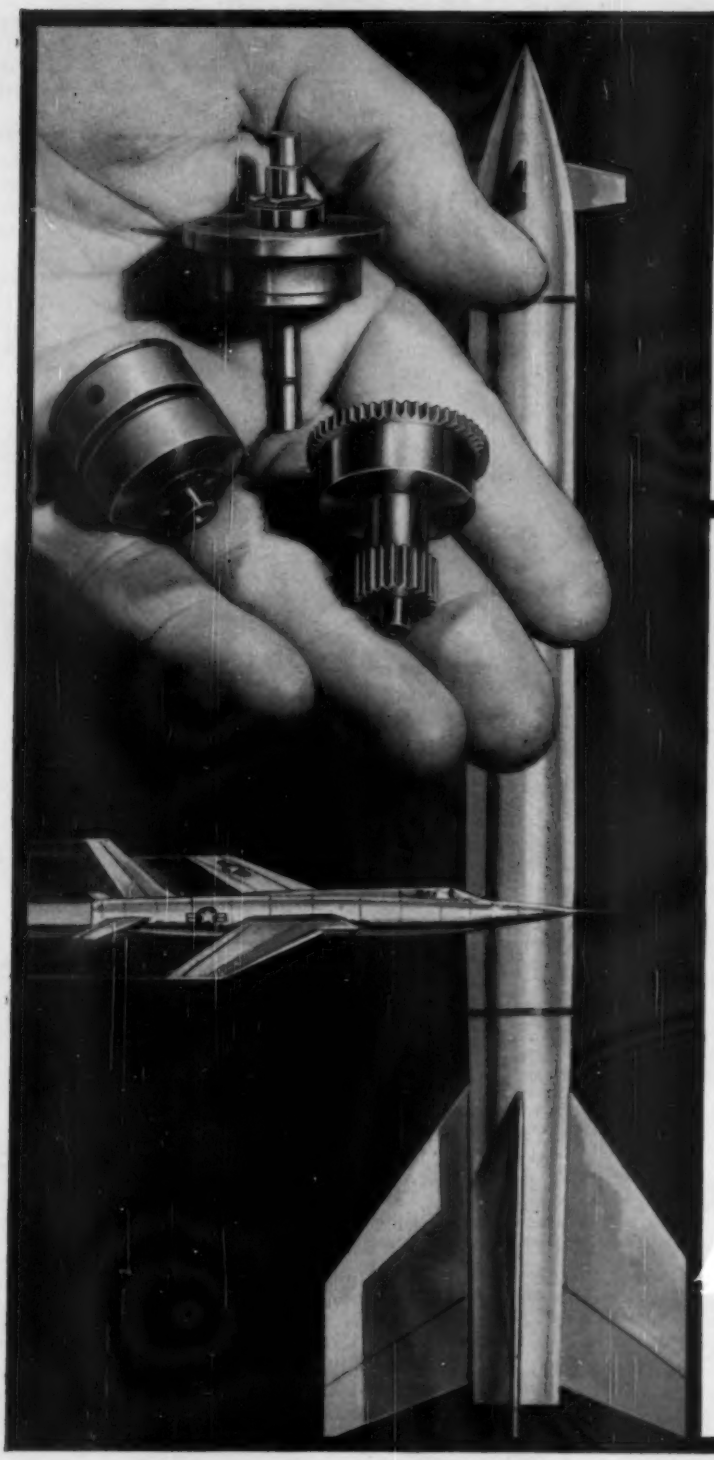
New exhibit represents a sharp reversal from an earlier attempt to devise a uniform design criteria. Under WADC contract, Radio Corp. of America visited major aircraft and avionic manufacturers in 1957 to obtain their views on preferred module dimensions, cooling provisions and vibration isolation. Results of this survey, recommending functional modules whose dimensions were considerably larger than BuAer's MIL-E-19600, were presented at a WADC meeting last summer to representatives of airframe and avionics industry.

Although many avionics manufacturers appeared willing, if not anxious, to go along with RCA's recommendations, the airframe manufacturers objected violently, because larger module dimensions would result in poor airframe space utilization.

As a result of this meeting, WADC and RCA decided to take a fresh look at the problem, and the new exhibit is the result. Wightman freely credits BuAer with having "pioneered" the new USAF modular concept in its MIL-E-19600. Air Force will incorporate MIL-E-19600 module dimensions with a few additional choices.

Exhibit will call for engineers to work to the following dimensions in designing modules for airborne avionics:

- **Height:** 4½ in. (fixed, not maximum



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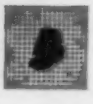

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dimension as in existing MIL-E-19600).
- **Width:** 3, 4½, 6 or 9 in. (3 in. is not presently included in MIL-E-19600).
- **Length:** In ½ in. increments, with no limit set.

Individual modules can be located and positioned in any convenient manner on "unit" chassis in order to achieve optimum packaging density. Standardized dimensions for such "units", called out in Air Force specification, include:
- **Height:** 6½ in. (allows 2 in. high base for forced air cooling plenum chamber).
- **Width:** 2¼, 3-9/16, 4¼, 7½, 10⅛, 15⅜ in. (width dimensions are multiples of 1-5/16 in.)
- **Length:** This dimension, determined by intended installation, should be established first. This in turn will determine required width of unit. Where specific airframe usage is not known, designer should use length of 14, 16 or 18 in.

Specification makes no attempt to standardize airframe rack design, leaving this to the individual aircraft manufacturer, except that it must be able to accept units with new standard dimensions.

For ease of interchangeability, specification says no controls, test points, meters or other external functions can be located on front panel of unit. They should be mounted inside the "unit" chassis and a front panel cut-out provided for access or "look through."

Main points of some other provisions

Auto-Landing Reflector

Radar cross section of Boeing 707 is increased by a corner reflector mounted on landing gear for recent tests of Bell Aircraft Corp.'s automatic all-weather landing system (AW July 28, p. 30). In tests, system landed jet without pilot touching controls.

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These amazing little fellows are so compact and weigh so little—you can save greatly on space and weight. So efficient—over 90%—you can use much smaller motors and gear boxes. So precise—you can position components within .0005 inch per inch of travel. (If application requires, lash can be eliminated.) So dependable—you can rely on remarkably long service life even in extremely adverse environments.

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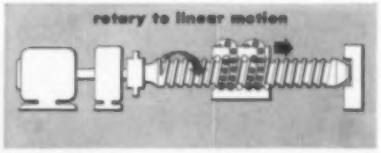
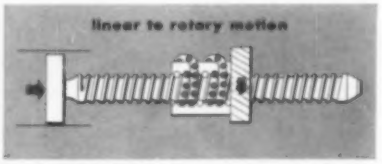


NUT TRAVELS: When rotary motion is applied to the screw, the b/b nut glides along the axis of the screw on rolling steel balls, converting rotary force and motion to linear force and motion with 4/5 less torque than acme screws.



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Static Line Retrievers are becoming standard aboard all Fairchild C-123 troop carriers

The Static Line Retriever, a precision airborne hoist developed by the Speco Division of Kelsey-Hayes Co., overcomes the air drag problem in retrieving exposed static lines during an air drop.

If a jumper's chute should become entangled, the Retriever is emergency geared in excess of 1000 pounds to pull him quickly and safely back aboard the plane. Similar airborne products developed by Speco include bomber, cargo and helicopter hoists and winches.

SPECO *is one of seven aviation divisions of Kelsey-Hayes devoted to the production of aircraft and missile components.*

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aircraft actuators, hoists, structures, fittings and controls, transmissions including helicopter and VTOL.

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of the exhibit include the following:

• **Vibration:** Airframe racking will provide shock, vibration isolation, and individual "units" will not be equipped with isolation mounts. Avionic unit must withstand double amplitude of 0.1 in or 5Gs, whichever is applicable, from 3 to 500 cps. There is no requirement beyond 500 cps.

• **Maintenance provisions:** Units must incorporate test provisions which permit rapid "go, no-go" trouble-isolation on flight line by low skill level technicians.

Copies of new Exhibit WCLN-58-18 can be obtained by writing: Commander, Wright Air Development Center, Dayton, Ohio, Attention: WCLNX–2.

FILTER CENTER

▶ **Transistor Preferred Circuits**—National Bureau of Standards program to develop preferred transistor circuits, similar to preferred tube circuits developed earlier, has run into a snag because of extremely wide variability of characteristics in transistors. Whereas transconductance of a group of MIL-standard tubes normally varies only ± 10%, corresponding important characteristics of transistors, such as short-circuit current gain, may vary 200% or more.

▶ **AMB To Test AN/GSN-5**—Bell Aircraft's AN/GSN-5 automatic flare-out and landing system, originally developed under Navy-Air Force sponsorship, will be evaluated by Airways Modernization Board at its National Aviation Facilities Experimental Center in Atlantic City. Production prototype equipment is slated for delivery to AMB in fall of 1959.

▶ **USSR Control Journal Translations**—English translation of leading Soviet automatic control journal, Avtomatika I Telemekhanika, is now available at reduced price as result of new National Science Foundation grant and arrangements to handle subscriptions through the Instrument Society of America. Translation will be made by Consultants Bureau, Inc., New York, as previously. Price of single issue will be $3.50. Year's subscription (12 issues) will cost $30 in U. S. and Canada, $15 for libraries of academic and other nonprofit organizations. Write: Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

▶ **Growing Avionics Inventory**—Dayton AF Depot, responsible for major share of Air Force's avionics supply and overhaul, currently stocks about 250,000 different items, and this figure increases by 3,000 every month. Of approximately 2½ million orders placed last year by USAF, 20% were handled by Dayton AF Depot, and percentage rose to 25% earlier this year.

▶ **Transistorized ECM**—Fully transistorized airborne reconnaissance system is being developed by Airborne Instruments Laboratory under Air Force sponsorship. System could find application in a reconnaissance satellite.

▶ **Hound Dog Guidance**—Guidance and control for North American's GAM-77 (Hound Dog) air-to-surface missile, being designed for use by B-52s, will be developed by NAA's Autonetics Division.

▶ **Hughes Proposes Satellite Relay**—Hughes Aircraft Co. is one of several companies that have submitted unsolicited proposals to military services for earth satellites intended for use as active or passive communication relay stations.

▶ **New Grid Improves CRT** – New three-grid electron gun for cathode ray tubes which provide high definition with driving voltages of only 2 to 6 v., instead of 50 to 70 v. formerly required for 525 line television picture, has been developed by Westinghouse Electric Corporation's electronic tube division,

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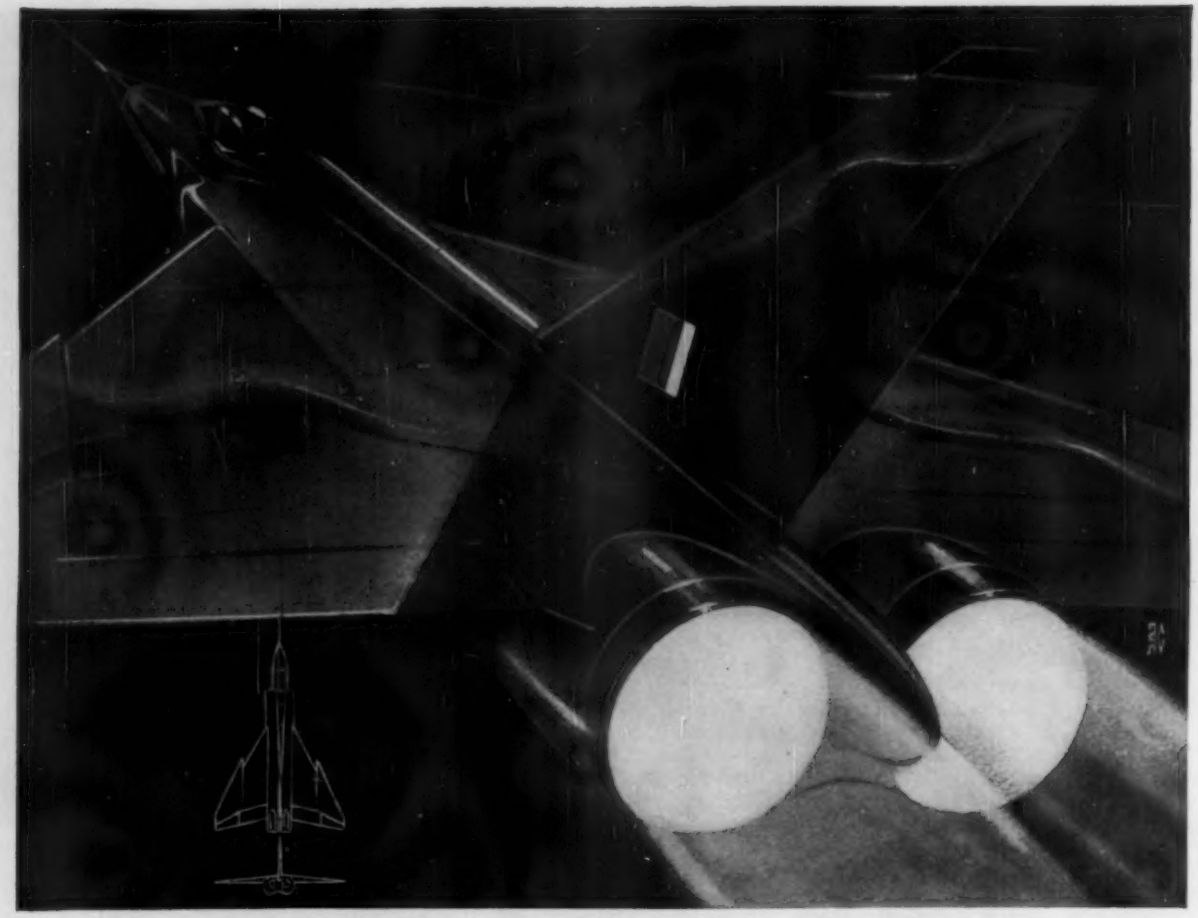

CF-105 ARROW 1 designed by Avro Aircraft Ltd., for the Royal Canadian Air Force.

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Elmira, N. Y. New gun contains driver grid, multiple-purpose screen grid and control grid. Modulation is applied to both screen grid and control grid.

▶ **Handy Chart**—Convenient chart which permits speedy conversion of torque and rpm into horsepower, for fractional horsepower motors, has been prepared by Avionics Division of John Oster Manufacturing Co. Chart covers range from 0.005 to 0.33 hp., from 1 to 14,000 rpm. For copy write company at Racine, Wis.

▶ **Whirling Dervish**—Closed-circuit television is used to read the indicator on an accelerometer while it is being rotated at high speeds in a centrifuge at Lear's Grand Rapids, Mich., plant. A Dage TV camera is mounted on the centrifuge itself, looking down on indicator, so there is no relative motion between the two. Television camera output is displayed on monitor scope which magnifies image by 2½ times, permitting extremely accurate readings.

▶ **Signed On Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **Ryan Aeronautical Co.,** more than $1 million, from Norden Division of United Aircraft, for Doppler radars to be used in bombing system for Navy A3D.

• **Sanders Associates,** Nashua, N. H., more than $½ million, for subminiature rate gyros to be used in Terrier surface-to-air missile.

• **Control Data Corp.,** Minneapolis, $600,000 contract, from Navy Bureau of Ships for large-scale digital computer.

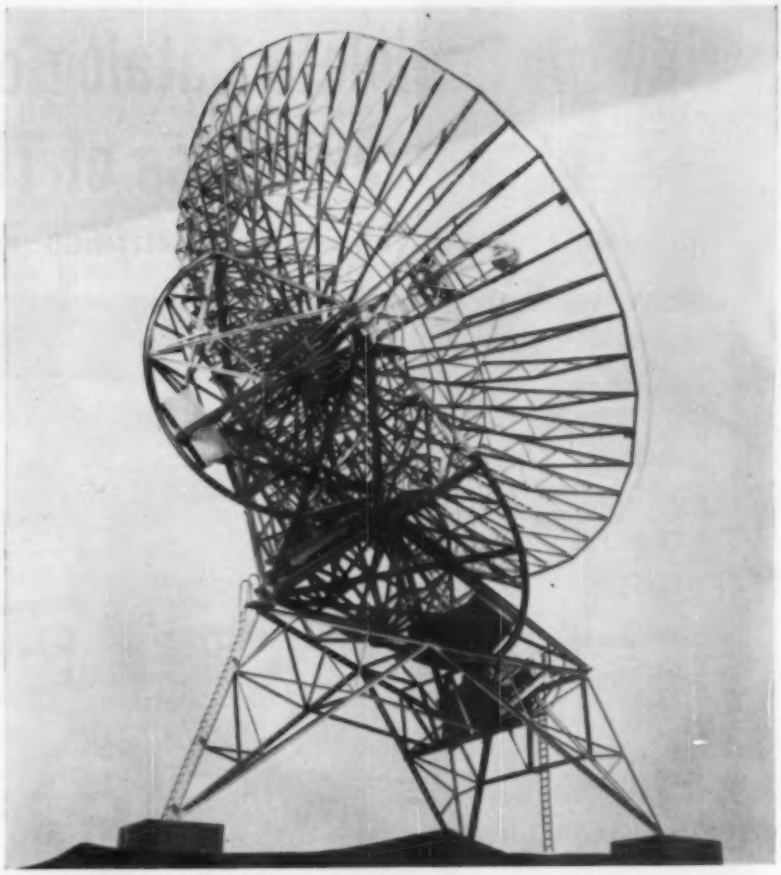
• **General Electric's** Heavy Military Electronic Equipment Dept., $12 million, from Air Materiel Command's Rome Air Force Depot for AN/FPS-7 long-range search radar.

• **The Siegler Corp.,** more than $500,000, from Army for construction of three satellite tracking stations by company's Hallamore Electronics Division, Anaheim, Calif.

• **Electronic Engineering Co. of California,** $125,000, from Systems Development Corp. for a computer-language translator system, designed to convert computer data from one format into another. Company also reports $500,000 award from Philco Corp. for instrumentation timing systems.

• **Telecomputing Corp.,** Los Angeles, two contracts totaling $1.2 million from Navy for electronic decoders and other classified equipment. Company's Brubaker Electronics Division, Culver City, will handle.

• **Packard-Bell Electronics Corp.,** $1 million, from Chance Vought Aircraft, Inc. for integrated communication-navigation-identification (CNI) packages.

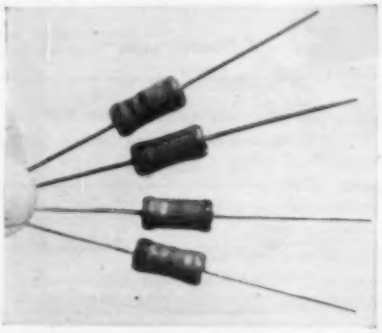


Space Communications Station Antenna

Lunar probe and other space vehicle communications will employ 85 ft. diameter antenna similar to model above. To be constructed by Jet Propulsion Laboratory at Camp Irwin, Calif., under contract with Army Ordnance Missile Command.

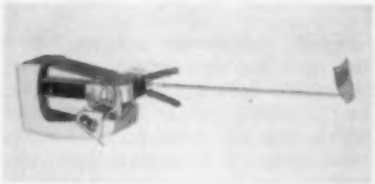
NEW AVIONIC PRODUCTS

• **Glass-based film resistor,** Type C-42, designed for industrial and military applications at temperatures to 150C, is being produced in the same price range as carbon composition resistors. Rated at two watts, resistor utilizes glass base with a tin oxide metal film, has a resistance range of 200 ohms to 1.5 megohms. It is capable of withstanding momentary overloads up to 250 times rated power at 70C. Corning Glass Works, Corning, New York.

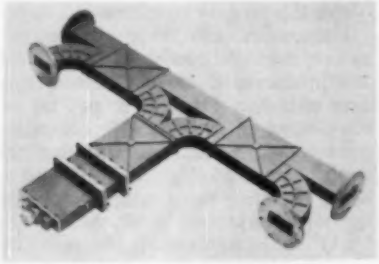


• **Tri-axial accelerometers,** Models 2230 and 2243, have a natural frequency of 25 kc. or higher. Sensitivities are 5 to 9 millivolts per G. Model 2230 operates over temperature range 63F to 200F, while Model 2243 operates from −100F to 500F, with maximum change in sensitivity of 10%. Three point

mounting is used to secure mating to test surface and orientation. Cases are electrically insulated from test structure. Units measure 0.75 x 1.25 x 1.31 in. Endevco Corp., 161 E. California St., Pasadena, California.



• **Lightweight moving coil indicator,** Model MEP-7, is for use with aircraft instruments requiring flag or alarm indications with short deflection angle. Unit uses an end-pivoted mechanism with internal pivots, high torque and a shielded magnet. Internal magnet design makes compass influence negligible. Marion Electrical Instrument Co., Grenier Field, Manchester, N. H.



• **S-band diplexer** Type BL-584, is used primarily for connecting two transmitters operating at different frequencies to a common antenna feed with low cross talk. Unit also separates two echoes at separate frequencies into the appropriate receiver channels. Pair of ganged plungers provides continuous variation of the two diplexing frequencies. Replaceable section makes possible diplexing of many combinations of frequencies. Bomac Laboratories, Inc., Salem Rd., Beverly, Mass.

• **RF power dividers,** covering the frequency ranges of 100-200 and 200-400 mc., are to connect a 50 ohm source to 2-20 loads. Each divider contains a low loss matching transformer section to minimize source mismatch. Input vswr is less than 1.25 and loss about 0.1 db. Power rating is 500 w. at 150F ambient. Special units are available for other frequency bands and for power levels to 100 kw., and for lower vswr. Adams-Russell Co., Inc., 292 Main St., Cambridge, Mass.

• **Transistor preamplifier series** provides impedance transformation while contributing 20 db. of gain. Units have been developed for use with high impedance sources such as accelerometers and hydrophones. Input impedance is one megohm, output impedance 600 ohms, equivalent input noise 10 microvolts, frequency response 100 to 80,000

cps. Units can be powered from an internal Mercury battery or external source for local or remote control. Models with higher input impedances also are available. Chesapeake Instrument Corp., Shadyside, Md.

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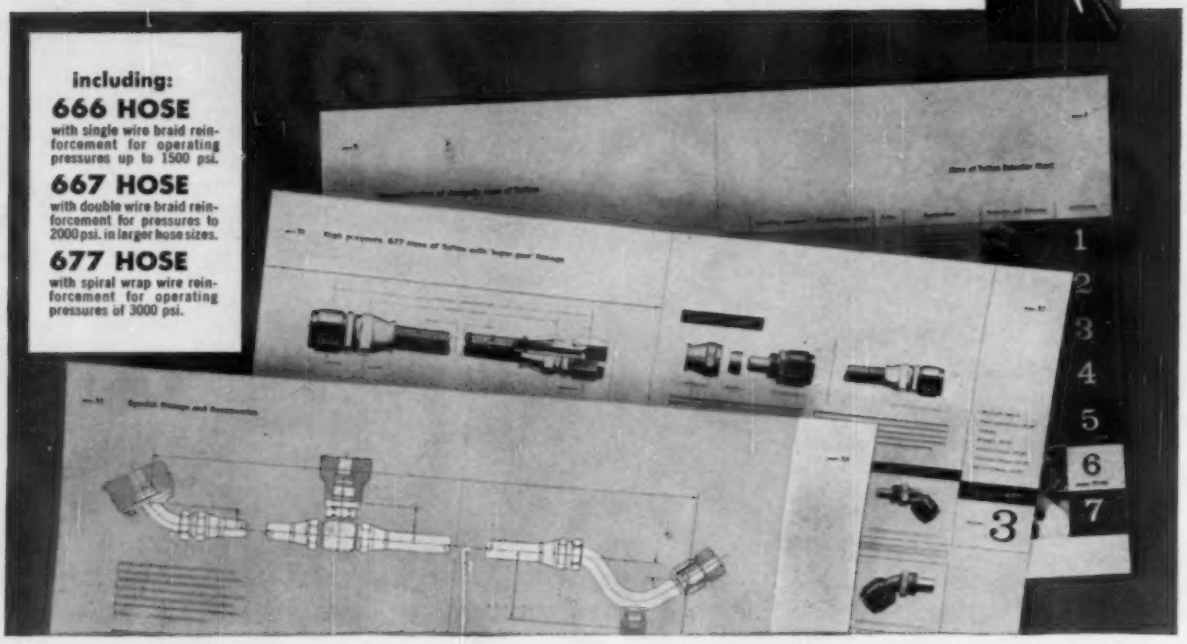

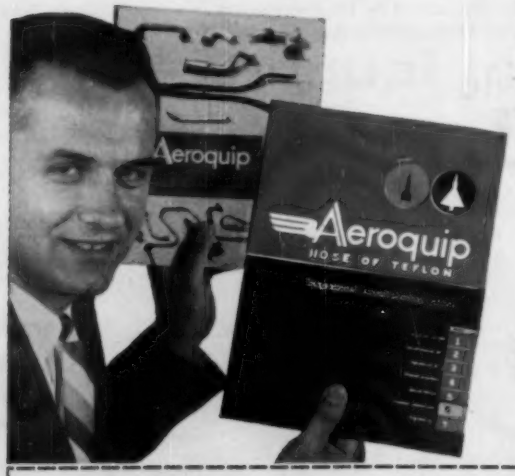

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agency headquarters. Test director also reports to commander of the center he represents.

During testing, evolution of such things as technical manuals and maintenance procedures are developed and the industry prime contractor or weapon system manager acts as a recommending party rather than being charged with actual manual and other procedures development in the complete sense. However, through Joint Test Staff efforts, material recommended by the contractor will about fit the requirements, since all agencies affected have had a hand in their formulation. Specialists such as operations analysts also figure in this picture, making their recommendations to the various agencies associated with development of manuals, procedures and techniques.

Test engineer complement is made up of engineers from the various commands interested in the weapon system, the using agency, the prime contractor and his associate or subcontractors as necessary.

In the case of the F-106, for which Col. Carl Ousley is test director at Edwards AFB, it is anticipated that introduction of the weapon system can be effected within one year, providing such items as the exotic MA-1 fire control system by Hughes qualifies completely.

In addition, for this weapon system, it is anticipated that using agency pilots will start working with the plane during Category II, much earlier than under the previous phase system. However, it is anticipated that in these early stages, ADC's best talent will take part, with the experience level gradually being reduced as the airplane becomes better known and understood. Ultimately the lower levels of operational pilots will be working with the aircraft.

B-58 to be Tested Under New Program

Ft. Worth—Convair B-58 is moving into a new flight test program which marks a major shift in Air Force philosophy on testing new weapon systems. This new concept is designed to get new systems into operational service faster by centralizing test efforts and overlapping test programs.

B-58 program centered here at Carswell AFB demonstrates the new USAF category testing concept in which the contractor, Air Research and Development Command and the USAF command which will operate the weapon system are all involved in its test program from beginning to end.

The new system has a number of advantages to the Air Force, but the key factor is the significant reduction in the time needed to get a weapon system

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USAF Modernizes Flight Test Program

By Richard Sweeney

Edwards AFB—New flight testing philosophy which more closely matches the weapon system design and management concept than the old phase system has been inaugurated within USAF.

Called Category Testing, it is being used on F-106A and B, F-105B, F-101B. F-106 is being handled at Air Force Flight Test Center here, while F-105B program is at Air Proving Ground Center, Eglin AFB (AW June 2, p. 20), as is F-101B. Forthcoming F-108 long range interceptor will be handled at Edwards.

Formerly, various centers within Air Research and Development Command had cognizance over testing various parts of a weapon system according to their mission and capabilities, i.e., nuclear weapons were assigned to Special Weapons Center, operational suitability and conventional weapons were the interest of APGC, all weather operations were accomplished at Wright Air Development Center. All flight test program was accomplished in eight phases.

Under the new system, one center is selected to handle the project by ARDC. Center commander designates an officer to be Test Director, the key man in the system, who is the manager for the entire flight test program.

Test Director organizes Joint Test Force, Joint Test Staff and line operating organization. Joint Staff has personnel from all ARDC centers which are involved with any part of the weapon system, each representing the area which is his center's particular interest.

Also represented on the joint test staff are Air Materiel Command, the using agency, Air Training Command, and the contractor who functioned as weapon systems manager.

In this, the contractor represents all his associate contractors such as powerplant, fire control, other systems and subsystems.

Assistant test director is representative of the using agency; in the case of the F-106, Air Defense Command. It is his responsibility to see that testing is what the ADC mission requires and is thorough enough to meet the using agency needs.

Joint Test Staff plans the Category I, II and III testing programs, which are flexible and have three basic changes from former phase test system. Now, phases are joined, the Joint Test Force concept allows one central manager, and while using agency's initial contribution is small, as program progresses, it becomes larger and larger.

Under this concept, a compressed test cycle leading to earlier operational status will be possible, with a "quick fix" capability on the production line which has not been possible before. Now, when a fix becomes indicated after malfunction discovery by any agency of the Joint Test Force, it can be remedied sooner on production lines. It has been estimated that having a fix incorporated on the production line three months ahead of when it was possible under the former test system, results in saving of $1 million.

Halfway through a category testing program, the using agency is contributing 50% of the personnel in the test program, and from this point on becomes the primary contributor.

Essentially, with the single manager and representative group making up the test programs, Category I testing consists of former Phase I, II and III accomplished in overlap, with contractor pilots doing preliminary investigations and followed closely by USAF pilots doing the same thing rather than waiting until contractor is all through for USAF to do its work. Additionally, as squawks develop they are ironed out, so that former Phase III also overlaps into earlier work.

Category II testing accomplished what was done in former Phases IV, V and VI. In Category I, final test results must show that a weapon system can and does operate as a system, within its normal operational environment.

Category III covers the work formerly accomplished in Phases VII and VIII. Here, using command predominates in personnel involved in the test program, and tactics for the weapon system are ironed out, techniques are developed and operational doctrine for employment of the weapon system is formed. This category is accomplished at the using agency base, in the case of F-106 and F-108, the Air Defense Command.

During the entire program, Weapon System Project Office personnel and Air Materiel Command personnel, as part of the Joint Test Force, are able to represent their particular headquarters in expediting funding, issuing production orders, rewriting contracts as necessary.

WSPO, which passes on test programs in general to see that its requirements are fulfilled, is kept abreast of test progress by test director. Additionally, reports go to the Air Materiel Command headquarters, and the using

Former Flight Test Phases

Edwards AFB—Eight phases formerly used in flight test are:

- **Phase I—Airworthiness and Equipment Functioning. Determines airworthiness and ensures that airplane and equipment will meet engineering specifications and will function. (Accomplished by the contractor.)**
- **Phase II—Contractor Compliance. Checks performance guarantees and determines the potential value of the aircraft to the Air Force. (Accomplished by AFFTC pilots.)**
- **Phase III—Design Refinement. Intended to overcome deficiencies revealed in other tests; continues until all required changes have been made. (Conducted by the contractor.)**
- **Phase IV—Stability and Performance. Involves testing performance and stability characteristics in detail, and the relaying of this data to the Fight Test Data Branch for use in checking contractor's figures. (Accomplished by AFFTC pilots.)**
- **Phase V—All weather. Performed to obtain information and data on the flying and handling characteristics of the aircraft under adverse weather conditions. (Accomplished by Air Force pilots at Wright Air Development Center.)**
- **Phase VI—Functional Development. Commands which will use certain aircraft send pilots and maintenance men to AFFTC to take part in these tests, which simulate operational conditions on night, weather, maximum range, gunnery and other missions.**
- **Phase VII—Employment and suitability. A test of tactically equipped aircraft or equipment to determine how they will perform under simulated and actual combat missions. (Conducted at Air Proving Ground, Eglin AFB.)**
- **Phase VIII—Unit Operational Employment Testing. Includes testing and evaluation of operationally configured equipment. (Conducted at an operational base with personnel and equipment authorized in a squadron.)**

Evaluation and Training Squadron under Col. Richard E. Evans. Since the program is in Category II, Col. Jones runs the show as test director with Evans and Col. H. J. McIntire of ARDC as deputy commanders. When the program moves into Category III and SAC takes responsibility, Col. Evans will take over as test director. Col. Jones is assigned directly to ARDC Headquarters and Col. Evans is assigned to the director of operations at SAC Headquarters, so lines of command are short and direct to top levels.

Convair, Air Materiel Command and Air Training Command personnel are also assigned to the Test Force. In the operating divisions, the team idea submerges the formality of the SAC and ARDC squadrons and mixes personnel from both organizations together in operating groups.

Test Force has now set up its procedures and communications and has formulated its test plan and an operations plan. Its first B-58 has been received from Convair and is now in the cold hangar at Eglin AFB, Fla., for climatic and cold weather testing. More airplanes are scheduled to be delivered to the Test Force out of the 30 ordered for test purposes, and Convair and the Test Force will each operate a pool of B-58s.

Current strength of the Test Force is 200, and further buildup in personnel will be concomitant with the receipt of more aircraft. Most ARDC personnel assigned to the program already are at Carswell, and with the buildup, which will extend over 15 months, SAC personnel will increase in numbers until they make up the bulk of the group in the fall of 1959. While ARDC is still running Category II, SAC pilots and crews will be observing the B-58 and forming ideas for the Category III program.

Programs already contracted for by Convair under the old phase testing programs are closely watched by the test group so it won't duplicate efforts. A mutual exchange of information between Convair and the group provides test results and experience on which the task force is building its program.

Certain jobs which cannot be done by the group at Carswell will be farmed out to test centers at Eglin AFB, Kirtland AFB and elsewhere. These centers will either send their experts to Carswell or will be assigned a B-58. But the main test function remains at Carswell, and all reports to the weapon system project office, including those for work farmed out, are written at Carswell.

Last November, Convair set up a customer service department under J. T. Cosby, the B-58 program director. It was designed to provide company support before and after delivery of the bomber to SAC. This department continues to operate under the new concept, and the assistant manager of the department, G. S. Green, is top Convair man in the task force.

Convair has started its training job on the B-58 with the establishment of a ground school. Two classes each of flight and ground personnel have gone through the various courses run by the company on its new weapon system.

By mid-July, about a dozen pilots had been trained and more were scheduled to start through the school. The pilots trained in ground school have not all been checked out in the airplane. In this part of the cycle, the training is chiefly for ARDC engineering test pilots, but SAC pilots will start going through in the fall. SAC maintenance men who will support the program begin a detailed maintenance and operations course in August.

Mobile training units and flight simulators will have their part in the training program. Convair is now building a unit which will include 17 training aids and 30 different panels to demonstrate the workings of the B-58 and its systems. Simulators are scheduled to be introduced into the program about the time the first B-58 is delivered.

Flight simulators will have a more important role in the B-58 program

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like the B-58 into service. Centralization of effort also cuts costs because fewer test systems are needed when the program is conducted in one place. This advantage cannot be claimed for the B-58 because it was ordered in test quantity before the new system was defined.

Another spur to the switch in testing technique was the fact that missiles do not adapt to the system of phase testing at various centers. The realities of missile testing force USAF to concentrate missile test programs at a single site, and the establishment and operation of the missile test center at Cape Canaveral, Fla., was a harbinger of the adoption of centralized category testing for all weapon systems.

For the contractor, there is little new in the types of test work and training it must do, but the timing is changed considerably. Convair's assistant manager of customer service, G. S. Green, points out that the telescoped, centralized program will keep the company close to the B-58 during the entire development period. And Convair will have a close-up view of the Mach 2 bomber in an operational environment when Strategic Air Command takes over the program.

Staying close to the B-58 will help Convair work out bugs and make changes in the production version before the airplane goes into service. It also helps Convair keep its subsystem vendors closer to the test program.

The B-58 program was the first to operate under the new concept, but others have begun to move in the same direction. Testing of the B-58 started under the old phase system, and Phases I and II had been completed when the switch to category testing was made. While Category I work is still going on, the program has now moved into the early stages of Category II.

To complete B-58 testing under the category plan, Convair, ARDC and Strategic Air Command are working together with other test force members in a program at Carswell AFB.

Choice of Carswell deviates from the standard pattern of using ARDC centers to host test programs, but it has the advantages of being next door to the Convair-Ft. Worth plant and being an operational SAC base.

Test force running the B-58 program began forming around the first of the year. Since then, there have been a series of policy letters which formulated the test force idea, although the group was formed without a detailed regulation from the Pentagon. The new concept actually involves a rewrite of Air Force Regulation 8014.

Carswell Test Force is composed of the 6592nd Test Squadron (B-58) from ARDC, commanded by Col. David M. Jones, and SAC's 3958th Operational,

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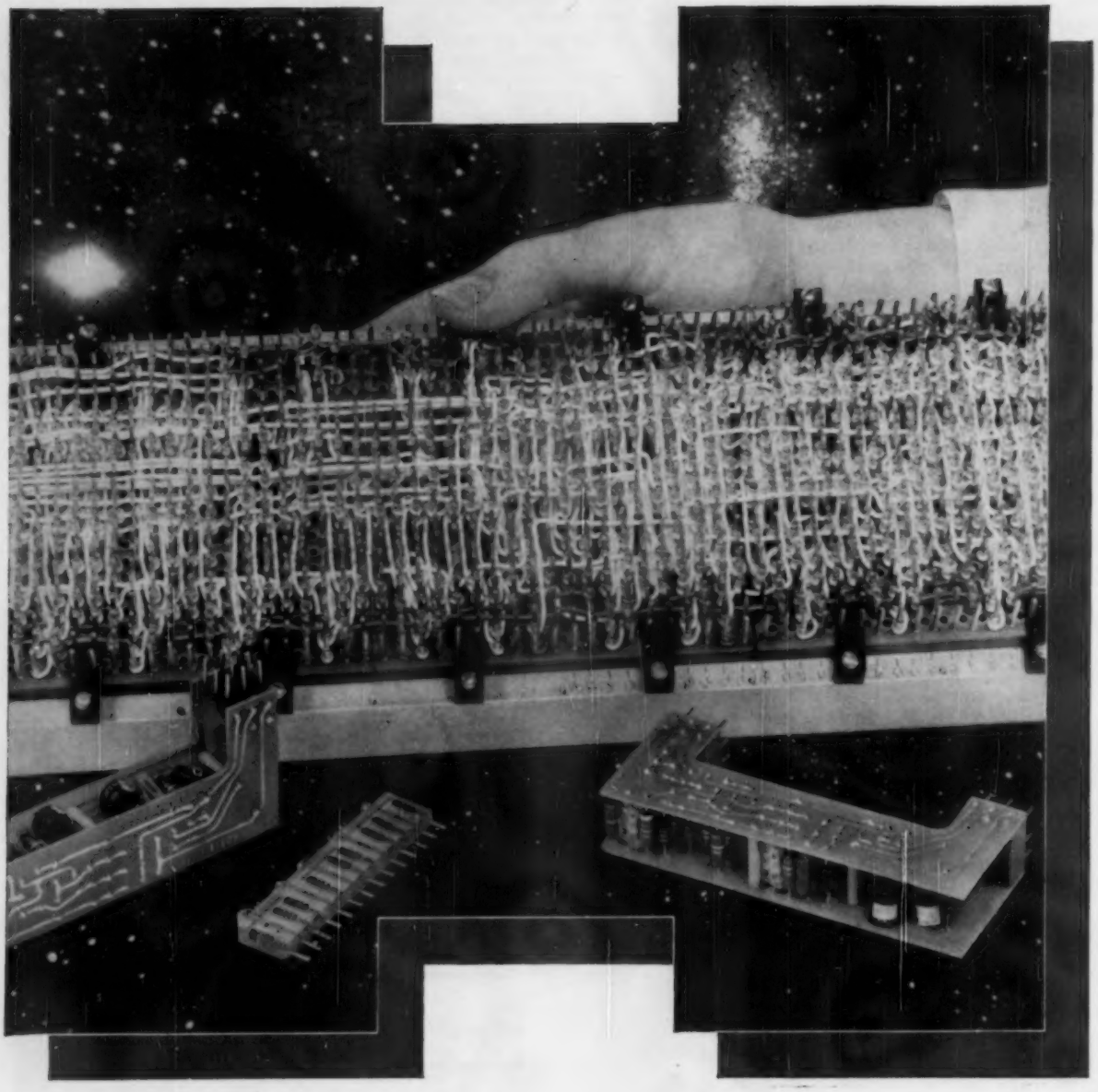

than they have had in previous bomber programs because of the fact that the airplane has only one pilot. Since there will be no check pilot along on the first flight, ground training assumes increased importance, and B-58 pilots will probably be more highly qualified for their first flight than pilots on previous bomber types. Convair and USAF expect no difficulties; they say pilots report the B-58 follows predicted characteristics very closely and is a "very forgiving airplane."

From its early B-58 flight experience, Convair decided the TF-102 had a place in training for the B-58, basically for orienting pilots in the flight characteristics of delta-wing aircraft. Test Force is checking the idea out, and the TF-102 probably will be used in the program for transition training.

Rolls-Royce RA.29 Overhaul Life Raised

London—British Air Registration Board has authorized overhaul life of 1,000 hr. for Rolls-Royce Avon RA.29. De Havilland Comet 4 and Sud Aviation Caravelle are powered with the 10,500 lb. thrust engines. Intensive engine tests started in September, 1957, when two Comet 2E aircraft, powered by two RA.29s and two earlier Avons, made daily scheduled flights from London to Beirut and back at aircraft utilization of 11 hr. per day. They accumulated 7,000 hr. flying time on the engines. Due to failure of ancillary unit, one RA.29 was removed prematurely. Engines were stripped and examined by the Air Registration Board at 250, 500, 750 and 1,000 hr. After 1,000 hr. the combustor cans showed no evidence of distortion and only slight traces of local excess heating. The cans are being re-used and are expected to give a further life without inspection of at least 750 hr. Wear was due to fretting because of the floating type of can location, according to Rolls-Royce. A large percentage of the parts rejected were non-metallic, mostly consisting of seals and gaskets. Metallic parts rejected consisted of pipes, pipe clips and fuel can radial support channels, Rolls-Royce said. Blading was found to be sound and will be re-used. Rolls-Royce spokesmen told AVIATION WEEK that they were confident of a 5,000 hr. life for the turbine blades and disks. Company revealed that it had operated disks of the Dart engine for periods "in excess of 8,000 hr."

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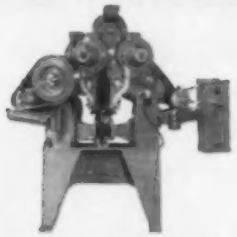

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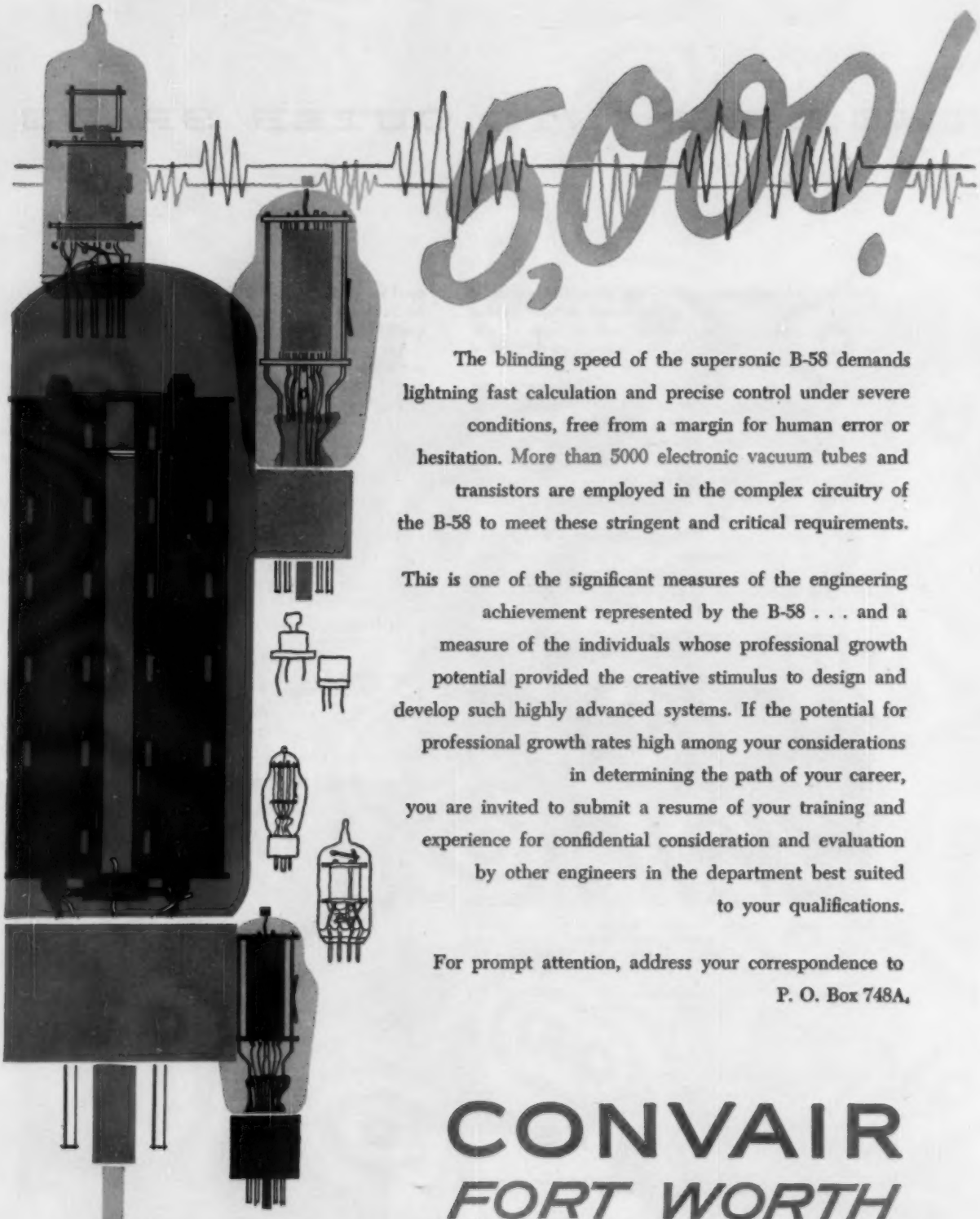

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Central Electronics Manufacturers, Inc., Denville, N. J., tube, electron, type 5680 in a/w spec. MIL-E-1C dated Oct. 3, 1955, and supplement 1J dated Nov. 30, 1956, and ISS-MIL-E-1/371A dated May 3, 1954, S/N 5960-248-3068, IFB-33-604-58-510, 500 ea., $31,160.

Eitel McCullough, Inc., San Bruno, Calif., tube, electron, pulse amplifier, type 6C21 in a/w spec. MIL-E-1C dated Oct. 3, 1955 and Amendment No. 1 dated April 29, 1957 and ISS-MIL-E-1/56B dated May 17, 1955, S/N 5960-114-3831, IFB-33-604-58-510, $42,750.

Hartman Electrical Manufacturing Co., Mansfield, Ohio, relay, MIL-R-26126 (USAF) dated April 16, 1957, MIL-R-9221 (USAF), Amendment No. 1 Dated July 10, 1956, S/N 5945-542-9596, RFP-33-604-58-2093, 3,122 ea., $63,051.

Raytheon Manufacturing Co., Newton, Mass., tube, electron, type 5678 in a/w spec. MIL-E-1C dated Oct 3, 1955 and amendment no. 1 dated April 29, 1957 and ISS MIL-E-1/281B dated June 18, 1957, S/N 5960-230-5262, IFB-33-604-58-597, 45,350 ea., $47,164.

Technology Instrument Corp., Acton, Mass., resistor-variable, linear precision, RFP 33-603-58-1920, 18 items, various quantities, $34,569.

Sylvania Electric Products, Inc., New York, tube, electron, MIL type in a/w spec. MIL-E-1C dated Oct. 3, 1955 and Amendment No. 1, dated April 29, 1957 and ISS MIL-E-1/3A dated Aug. 23, 1955, S/N 5960-262-0167, IFB-33-604-58-665, 300,-000 ea., $267,000.

Raytheon Manufacturing Co. Newton, Mass., tube, electron, MIL type 12AT7WA in a/w spec. MIL-E-1C dated Oct. 3, 1955 and Amendment No. 1 dated April 29, 1957 and ISS MIL-E-1/3A dated Aug. 23, 1955, S/N 5960-262-0167, IFB-33-604-58-665, 100,-000 ea., $82,400.

Cutler-Hammer, Inc., Dayton, Ohio, microphone switch, in a/w spec. MIL-S-6744 dated June 14, 1950 and drawing MS25039 dated Aug. 25, 1955, S/N 3360-394427576, IFB-33-604-58-531, 7,000 ea., $25,837.

Consolidated Airborne Systems, Inc., Mineola, N. Y., tester, capacitor type, fuel quantity gage tank unit, type MD-2A in a/w spec. MIL-T-4687B, 100 ea.; photographs, 3 ea.; maintenance handbook data, engineering data, RFP-33-604-58-2120, $141,305.

Magnaflux Corp., Chicago, Ill., magnetic inspection unit, type MB-2 (WCRTL), type II in a/w exhibit WCRTL dated April 7, 1954 and Amendment No. 2 dated Feb. 4, 1955 and exhibit "3," PR: MD-8-17C-13226 and 13283, 18 ea., $91,815; magnetic inspection units, stationary, spec. exhibit WCRTL-1, type MB-3, S/N 7CAD-484200, PR: MD-8-17C-13227, 15 ea., $85,227.

Navy Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by U. S. Navy contracting offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia, Pa.

Sundstrand Aviation Division, Sundstrand Machine Tool Co., Rockford, Ill., junction boxes, N383-52758A(383/2140-21477 E4/1/55), 38 ea., $36,588.

Acushnet Process Co., New Bedford, Mass., oxygen masks, N383-53177A(IFB-383-829-58), $89,492.

The Rotlan Co., Topsfield, Mass., antennae transmitting and receiving, N383-53705A(JD-IFB-383-678-58), 3,300 ea., $35,376.

M. Steinthal Co., New York, parachute assemblies, N383-52589A(IFB-383-623-58), 520 ea., $69,940.

Federal Aircraft Works, Inc., Minneapolis, Minn., skis, model A40000, modified as necessary for use on R4D-8 aircraft, N383-(17)53278A(PREN-11-3480/58), 3 sets, $88,-350.

The Pierce Governor Co., Anderson, Ind., maintenance parts used on AE32B1 valve for FJ3 aircraft, N383-53488A(383/2150-29891/55), $26,201.

Goodyear Aircraft Corp., Akron, Ohio, visor assemblies, for use with APH-5 protective helmet, N383-52551A(383/9045-22740 F1/3/58 and 383/9045-22743 F1/3/58), $464,960.

Control Electronics Co., Inc., Huntington Station, N. Y., frequency calibrators, Army-Navy type, N383(MIS52776A)-(MIPR-RO2-890177-SC-01-23) and (MIPR-33-604-8-17C-5181), $25,330.

Chandler-Evans Division, Pratt & Whitney Co., Inc., West Hartford, Conn., maintenance parts, used on various assemblies, N383-53141A(383/2110-29842 X3/2/55), $51,517.

Eastman Kodak Co., Rochester, N. Y., film, photographic, MIL-No. 1, core, N383-53188A(383/12NSF/280/F2/7/58), $28,602.

Breeze Corp., Inc., Union, N. J., lead assembly-detachable spark plug, N383-53133 (383/7126-28700/57), 52,344 ea., $197,860.

Vertol Aircraft Corp., Morton, Pa., bearing for use on helicopter, N383-53301A(383/2110-210276 A5/1/55), 1,200 ea., $40,236.

Scintilla Division, Bendix Aviation Corp., Sidney, N. Y., maintenance parts, J57 aircraft engines, N383-(MIS)53123A(MIPR-41-608-030-2924), $137,340.

George Senn, Inc., Philadelphia, Pa., compound, grease cleaning, solvent emulsion type, N383-5q883A(383/9081-24508 G4/1/58), $89,270.

Pioneer-Central Division, Bendix Aviation Corp., Davenport, Iowa, technical publications, alternate "C," N383(17-383)-53601A(IFB-383-689-58), 935 ea., $349,737.

Douglas Aircraft Corp., El Segundo, Calif., special support equipment for A3D and A4D aircraft, N383-52483A(383/8164-27844S3/58), $79,188.

Chicago Aerial Industries, Inc., Melrose Park, Ill., spare parts for camera control system installed on aircraft, N383-52718A (383/2110-22649 F/2/55) and (383/6112-22659 F2/56), $803,971.

Western Gear Corp., Lynwood, Calif., gear boxes for various aircraft, N383-52390A(383/2110-29718 X1/1/55), $32,082.

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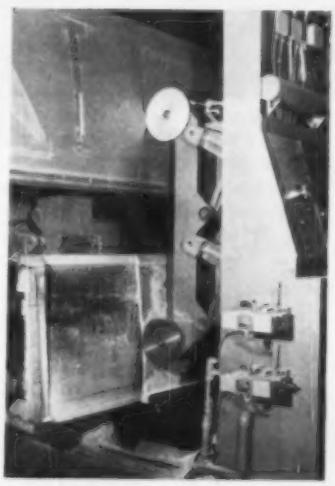

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ENGINEERS — INVESTIGATE JOB OPPORTUNITIES WITH A FUTURE

Certificates of Necessity

Washington—Office of Defense Mobilization has awarded the Callery Chemical Co., Douglas County, Kans., a certificate of necessity for accelerated tax amortization in the amount of $3,832,700 with 65% of the amount allowed at the rapid rate. The certificate is for high energy fuels for missiles and military jet aircraft. Other certificated awards are:

Aerojet-General Corp., Azusa, Calif., research and development of military infrared detection systems, $964,917 with 60% allowed.

Missile Systems Division, Lockheed Aircraft Corp., Van Nuys, Calif., research development and fabrication of missiles, $382,185 with 65% allowed.

Missile Systems Division, Lockheed Aircraft Corp., Van Nuys, Calif., research, development and fabrication of missiles, $253,982 with 65% allowed.

Missile Systems Division, Lockheed Aircraft Corp., Sunnyvale, Calif., research, development and fabrication of missiles, $403,864 with 65% allowed.

Missile Systems Division, Lockheed Aircraft Corp., Palo Alto, Calif., research, development and fabrication of missiles, $259,443 with 65% allowed.

Missile Systems Division, Lockheed Aircraft Corp., Palo Alto, Calif., research, development and fabrication of missiles, $223,879 with 65% allowed.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., research and development of aircraft components, $152,050 with 40% allowed.

WHERE'S THE MAN WITH THE SLEDGE?

Propeller shaft thrust nuts are normally tightened by hitting the handle of a 3-foot wrench with a bronze or lead mallet. Tightening by this "shock" method sometimes produced a false sense of tightness. Some nuts loosened in service.

Airwork believed the natural elasticity of the metal might be the problem. So they built this hydraulic nut tightener. Now thrust nuts are tightened by evenly applied force through a pre-determined arc; the exact number of degrees specified by the factory.

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USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Air Force contracting offices:

DAYTON AFD, USAF, Gentile AFS, Dayton 10, Ohio.

Westinghouse Electric Corp., Dayton, Ohio, magnetron tube, type 6249A in a/w spec. MIL-T-8128A dated April 10, 1956, S/N 5960-504-8555, PR: MD-8-5960-31064, 2,600 ea., $883,038.

Telectro Industries Corp., Long Island City, N. Y., oscillator, type TS-382 F/U in a/w spec. MIL-A-4291B dated May 2, 1956, S/N 7CAC604344-5, 2,918 ea.; technical publication requirements for test equipment, Air Force drawings and data list requirements, electron tube complement report, in a/w form DD-816 and spec. MIL-E-16400B, provisioning data, IFB-33-604-58-387, $620,837.

Stewart-Warner Electronics, Chicago, modification kit MK-102, in a/w spec. MIL-M-9413A, USAF, dated Sept. 7, 1955 and Amendment No. 1 dated Aug. 24, 1956, S/N 1660-12P4-2APX6-506(IFB-33-604-58-581), maintenance parts, 4,662 ea., $239,887.

Microwave and Power Tube Operations Division, The Raytheon Manufacturing Co., Waltham, Mass., tube, electron, Klystron, metal envelope, MIL type 726C in a/w MIL-E-1C, dated Oct. 3, 1955, Amendment No. 1, dated April 29, 1957 and ISS-MIL-E-1/726C, dated Jan. 11, 1950, 2,324 ea.; tube, electron, Jan type 2K29 in a/w Spec. MIL-E-1C, dated Oct. 3, 1955, Amendment No. 1, dated April 29, 1957 and ISS-TSS Jan 2K29, dated Nov. 15, 1945, 115 ea., IFB-33-604-58-614, $62,555.

Westinghouse Electric Corp., Elmore, N. Y., inspection and repair of tubes, magnetron, Type No. 6249, S/N 5960-275-2989, 3,000 ea.; magnetron, Type No. 6249A, S/N 5690-504-8555, 3,000 ea., PR's MD-8-16S-9320 and -9321, $66,000.

Lear, Inc., Grand Rapids, Mich., test panel, followup control, Lear P/N LT-3077, S/N 7CAC-801317-53, RFP-33-604-58-2015, $43,747.

Eicor Division, The Scranton Corp., Chicago, Ill., inertia switch, Eicor P/N SW1253A, S/N 5930-327-7136, PR Nr. MD-8-5930-61932, 6,000 ea., $48,000.

Transco Products, Inc., Los Angeles, Calif., switch, RF, Transco, P/N 11300, S/N 5985-504-8506, PR-MD-8-5985-20013, 400 ea., $29,300.

Kearfott Co., Inc., Little Falls, N. J., reproducible copy for handbook instructions and parts breakdown covering test equipment, call no. 33-604-58-1, 21 items, $80,000.

Standard Electrical Products Co., Dayton, Ohio, switch, push, SPST, Standard Electrical Products P/N 7211 appl: F-86 rocket assembly, S/N 5930-573-0561 (IFB-33-604-58-669 and Amendment No. 1), 15,000 ea., $112,200.

Small Motors, Inc., Chicago, Ill., motor, dc, Small Motors P/N SM-2-263-1, NSL-RFP-33-604-58-2546, 5,000 ea., $87,250.

Microwave and Power Tube Operations Division, Raytheon Manufacturing Co., Waltham, Mass., inspection and repair of tubes, magnetron type 6249, S/N 5960-275-2989, 3,000 ea., magnetron type 6249A, S/N 5960-604-8555, 3,000 ea., PR's MD-8-16S-9320 and 9321 $66,000.

Microwave and Power Tube Operations Division, Raytheon Manufacturing Co., Waltham, Mass., tubes, electron, magnetron, type QK470 un a/w RADC exhibit 2478 dated Dec. 14, 1955, S/N 5960-503-4506, PR 30552 and Amendment No. 1, 250 ea., $644,500.

Hartman Electrical Manufacturing Co., Mansfield, Ohio, cutout, reverse current, AN3025-600, revision 6 dated, May 21, 1956, and Amendment No. 2 dated, July 5, 1957, S/N 3280-218800-3155, RFP-33-604-58-2402, 1,320 ea., $46,200.

Microwave and Power Tube Operations Division, Raytheon Manufacturing Co., Waltham, Mass., backward wave oscillator tubes, Raytheon type QK625 in a/w Raytheon spec. dated, Aug. 9,1957, S/N to be assigned, PR: MD-8-5960-30575, 500 ea., $1,287,500.

Bruno-New York Industries Corp., New York, multimeters, AN/PSN-6 in a/w spec. MIL-M-4552B (USAF), dated Aug. 23, 1957,

SIKORSKY will send its first S-62 on a demonstration tour of the U. S. and Canada this fall. Second S-62 will be used for type test and military evaluation. Decision has been made to build a third S-62 for engineering development projects and CAA testing.

Race for Turbine Helicopter Sales Starts

Commercial sales efforts for the first U. S. designed turbine helicopters intensified last week with these developments:

• **Bell Helicopter Corp.** officials met with Civil Aeronautics Administration to plan certification of the Bell HU-1, designated Model 204 in its commercial version. Army YH-40, a service test version of the HU-1, was used for CAA familiarization demonstrations.

• **Sikorsky Aircraft Division** of United Aircraft Corp. removed test equipment and began conversion of its first S-62 to a demonstrator for a tour of Canada and the U. S. to begin this fall. The second S-62, which is near rollout at Sikorsky's Bridgeport plant, will be used for type test and military evaluation. The third ship, which Sikorsky has just decided to build, will be used for engineering development projects and CAA testing.

• **Vertol Aircraft Corp.** spokesmen said that the T53-powered 107 would be available to commercial operators in 1961. Thus far no certification schedule has been arranged with CAA. Ten military models of the 107, the YHC-1, have been ordered by the U. S. Army with first delivery expected in approximately eight months.

CAA can complete the certification program in six to nine months. Bell is not ready yet to take commercial orders for the HU-1, but will make the helicopter available as soon as military production permits.

Results of company test programs can be utilized in meeting CAA test requirements. Sikorsky, for example, has begun a company program of rough water tests for the amphibious S-62.

Initial results, in a Force 2-3 sea in Long Island Sound (waves 3-5 ft. high), were good, the company said. The ship remained dry and stable, the company said, the tail rotor remained clear of water and no water entered the intake of the General Electric T58 engine. Landings were autorotative into a 15-20 kt. wind, resulting in a touchdown speed of 10-15 kt.

The S-62 will be demonstrated at

BELL plans Civil Aeronautics Administration certification of its HU-1, designated Model 204 in its commercial version. YH-40 (above), service test version of HU-1, was used in CAA demonstrations.

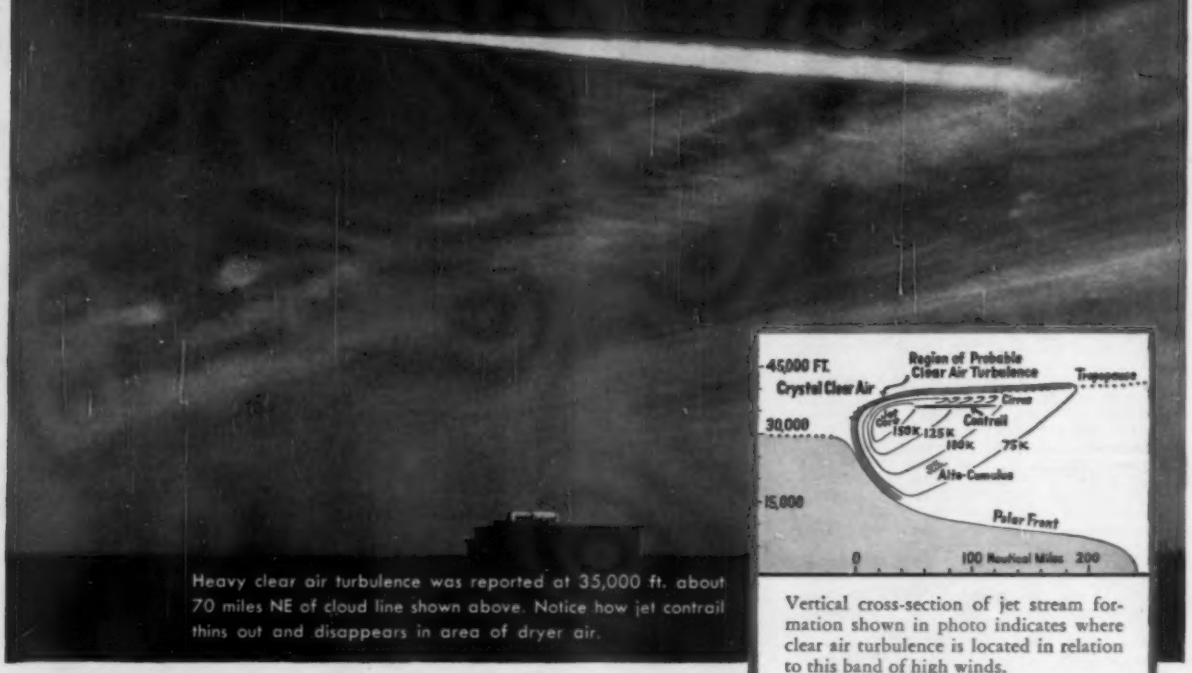
FLY WEATHER-WISE

Mobil

These weather items prepared in consultation with the United States Weather Bureau

CLEAR AIR TURBULENCE

HOW IT AFFECTS HIGH-ALTITUDE FLIGHT



Heavy clear air turbulence was reported at 35,000 ft. about 70 miles NE of cloud line shown above. Notice how jet contrail thins out and disappears in area of dryer air.

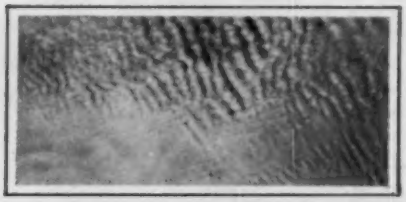
Vertical cross-section of jet stream formation shown in photo indicates where clear air turbulence is located in relation to this band of high winds.

FLIGHTS in the 20,000 to 40,000 ft. levels often encounter clear air turbulence. It is more of a cobblestone variety than the drafts associated with vertical currents in cumulus clouds. Though brief, this effect may be severe.

Clear air turbulence is caused by turbulent eddies in regions of marked windshear, that is, wherever wind velocities (speed and direction) vary sharply over short distances. It is generally associated with the tropopause and edges of the jet stream.

Conditions to watch for in flight: Haze and cirrus clouds at or near flight level. Rapid temperature changes. Fluctuations of airspeed indicator. All can indicate approaching turbulence.

What to do when turbulence is encountered: Reduce speed. This may reduce severity of jolting. Change altitude. Change direction till turbulence ceases, then resume heading.



Alto-cumulus billows associated with jet stream. Cobblestone turbulence is sometimes encountered above these clouds in clear air.

Photograph courtesy Munitalp Foundation, Fostering Pure Research in Meteorology.

How Mobil fuels meet requirements for high-altitude flight:

Mobiljet fuels flow freely, give maximum performance. Various grades permit operation over a range of temperature from —76°F to + 100°F. Volatility characteristics allow easy starting on ground and at altitude . . . prevent rapid evaporation, vapor formation as altitude increases.

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Toronto, Ottawa and Montreal for civil and military representatives Sept. 4-12. It will go to Philadelphia Sept. 24 for demonstrations at a state aviation officials convention and later to the South for a two or three week tour of military bases.

Bell uses the Lycoming T53 turbine powerplant. This is currently in process of certification at Lycoming's Stratford, Conn., plant. A batch of six YH-40 helicopters is currently being delivered to the U.S. Army for service test. Last of the six will be delivered late in August. Production model, the HU-1, will start coming off the line this fall.

Of the six Y models, one will remain with Bell, as will all three XH-40s. One YH-40 is at Eglin AFB for climatic and cold weather test, one is at Edwards AFB for Air Force testing and one is at Yuma, Ariz. for desert tests. This Yuma ship will go to Ft. Rucker later, and the remaining two Y models are also scheduled for Ft. Rucker.

The six-place helicopter has a climb rate in excess of 2,000 ft. per minute, a ferry range of more than 600 mi. and a cruise speed of 115 mph.

These are the changes between X and Y models, as detailed by project engineer Jack Buyers:

- **Cabin has been lengthened** 12 in., giving it a capacity of four litters instead of two.
- **Ship has been raised** four inches on its skid gear, providing more ground clearance and much easier maintenance.
- **Change in engine** air inlet ducts gives improved engine performance.
- **Top cowl line** has been straightened, improving engine air intake system.
- **Y model has hydraulically** operated ground-handling wheels instead of manually operated wheels.
- **A low-ratio stabilizing** bar has been installed on top of the rotor, increasing stability.
- **Two vents** on top of the forward cabin improve cockpit ventilation.
- **Stick-centering** or artificial fell units have been changed from hydraulically-operated units to magnetic brake units, improving the pilot's control feel.
- **A compensator** which mechanically ties the collective pitch system into the engine governor control has been installed. This maintains engine speed constant with changes in collective pitch.
- **Crew door has been widened** four inches for easier entrance.
- **Lycoming T53 turbine engine,** which is rated at 860 shp., is derated to 770 shp. on the Y model. It was derated to 700 shp. on the X model.

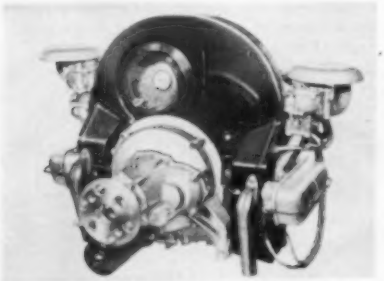
A fourth turbine-powered helicopter offered to the civil market is the Republic-assembled French Alouette, designed by Sud Aviation. The helicopter has received CAA certification and two commercial models have been delivered. A third Alouette is scheduled to be delivered next week.

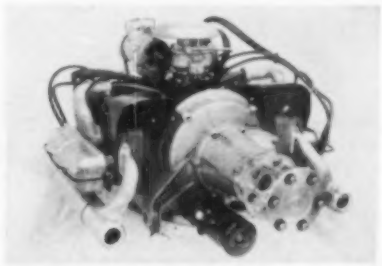
Porsche Engine Passes Tests, Enters Light Plane Market

Hanover—Porsche 678 engine is the first German aircraft powerplant to be developed since the war. This 65 hp. version of the Porsche air-cooled, flat-four automobile engine was one of many examples of Germany's aviation development demonstrated at an air show held at Langenhagen airport near here (AW, May 26, p. 111).

The engine has completed its 150-hr. British Certificate of Airworthiness test after three years of stand and flight testing. Porsche has since sold engines to Rhein-Flugzeugbau Gm.b.H., Krefeld, for the company's Multoplane RW.3 two-seater, and to Pützer K.G., Bonn, for the Pützer Elster two-seater lightplane. Pützer is now considering using the engine to power its Morab lightplane.

Next customers on Porsche's list of prospective buyers are expected to be the Aero-Flugzeugbau Hubert Zuerl, Heimstetten near Munich-Riem, and





PORSCHE 678/0 engine (left) has takeoff rating of 65 hp. at 4,500 rpm., costs $1,380. Engine at right is Porsche Type 678/1, which powers Aero-Jodel D-11A "Club."

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Please write to: Mr. A. H. Stevenson, Engineering Personnel, North American Aviation, Los Angeles 45, California.

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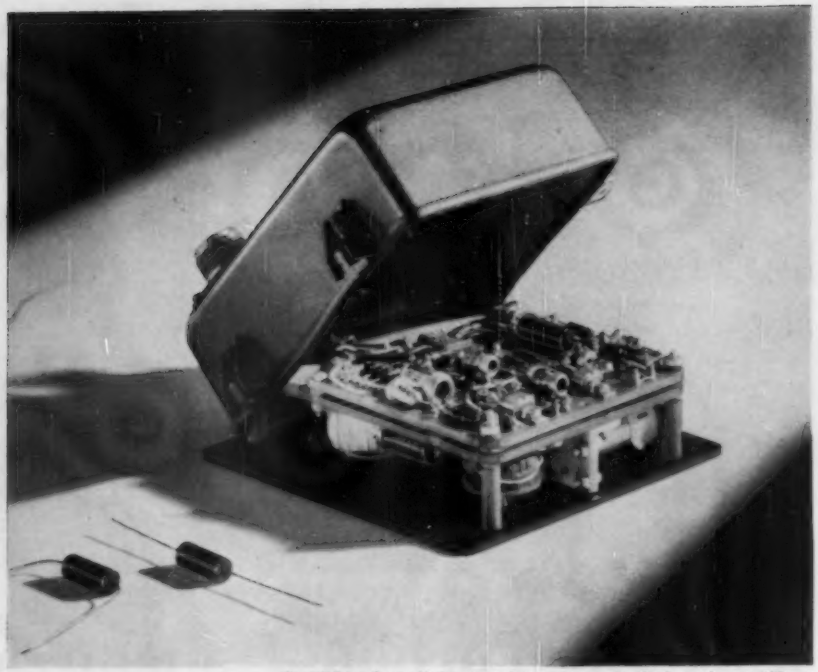

Amplifier for oil temperature servo control system utilizes Airborne miniaturized "Mylar" capacitors to save weight and insure high reliability. Entire system, including rotary actuator, is Airborne produced and is designed to meet specifications MIL-E-5272A, MIL-E-5400A, etc. Environmental requirements include −65 to +200°F. and up to 60,000 ft. altitude.

Developed originally for motor start and run purposes, Airborne miniaturized "Mylar" capacitors are currently finding increasing application in electronic circuits where small size, light weight, and high reliability are of paramount importance.

Typical of such applications is one of our *own* servo control amplifiers, shown above. Used as a component of an Airborne-designed oil temperature control system for high performance aircraft, the amplifier consists of a .1% precision resistance bridge, stable feedback transistor amplifier, reference oscillator, phase demodulator, and relay output amplifier. Production units employ printed circuitry.

Two of Airborne's miniaturized "Mylar" capacitors are utilized in this particular amplifier — a .1 mfd unit for tuning in the reference oscillator section of the amplifier and a .02 mfd unit for phase shift correction in the stable feedback transistor amplifier section. Capacitors are epoxy encased and are designed to meet or exceed Government specification MIL-C-25A.

Wound of thin metallized "Mylar" film, Airborne miniaturized capacitors are rated up to 600 v d-c, 330 v a-c and have an operating temperature range of −75 to +300°F. At 300°F they will withstand 120% rated voltage for 250 hr.

Write, phone or wire for more information on Airborne special design miniaturized "Mylar" capacitors. Inquiries are also invited on complete electromechanical control systems.

*Du Pont's trademark for its polyester film

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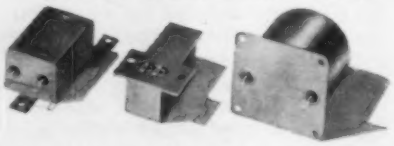

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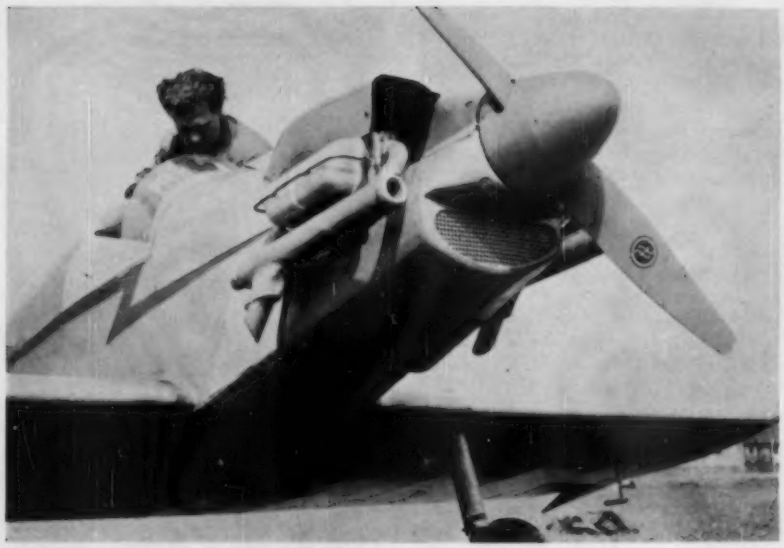


ENGINE is mounted for test in Jodel Bebe light monoplane. Company is interested in Porsche Type 678/3 which weighs 188 lb., is lightest of three types in production.

Carl-Heinz Nietsche, Neuburg/Donau. Both firms are making Jodel lightplanes under license from Jodel S.A., Beaune, France; Aero-Flugzeugbau the Aero-Jodel R-11A "Club" sport plane and trainer and Carl-Heinz Nietsche the Jodel Bebe lightplane. In addition, the Porsche company says that Piper Aircraft Corp., Lock Haven, Pa., has inspected the engine.

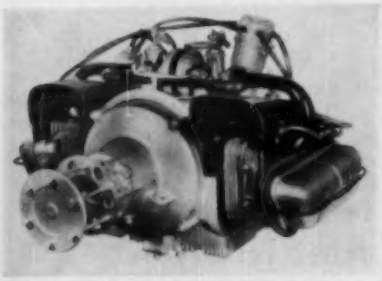
Three different models are available:

• **Type 678/0** is a geared engine with a ratio of 1.7 : 1. Takeoff rating is 65 hp. at 4,500 rpm., maximum cruise rating is 60 hp. at 4,380 rpm. and most economical cruise is 50 hp. at 4,120 rpm. Corresponding fuel consumptions are: 5.8, 5.3 and 4.5 gal./hr. Total weight of the engine is approximately 247 lb. and its measurements are: length 28.03 in., width 32.09 in., height 25.39 in. Cost of this model in Germany is the equivalent of $1,380.

• **Type 678/1** is a geared engine with a ratio of 2.12 : 1. Takeoff rating of this model is 65 hp. at 4,500 rpm., maximum cruise rating is 55 hp. at 4,200 rpm. and most economical cruise is 50 hp. at 4,08 rpm. Corresponding fuel consumptions are: 5.5, 4.5 and 4.1 gal./hr. Total weight is approximately 234 lb. and the engine measures: length 28.58 in., width 31.49 in. and height 20.45 in. Cost is $1,235. This is the model that powers the Aero-Jodel D-11A "Club" sport plane.

• **Type 678/3** is a direct drive engine. Takeoff rating is 52 hp. at 3,200 rpm., maximum cruise rating is 50 hp. at 3,150 rpm. and most economical cruise is 40 hp. at 2,950 rpm. Corresponding fuel consumptions are 4.4, 4.1 and 3.2 gal./hr. Total weight is approximately 188 lb. and measurements are: length 22.99 in., width 31.49 in. and height 19.09 in. Cost of this type is $1,030. This engine powers the Jodel Bebe lightplane.

All three models use 80-octane fuel.



THIRD engine in Porsche series is Type 678/3, rated at 52 hp. at 3,200 rpm.

Lockheed Subsidiary Gets AMB Contract

Cost-plus-fixed-fee $405,810 contract covering maintenance, fueling, inspection, servicing and repair of aircraft at National Aviation Facilities Experimental Center of the Airways Modernization Board at Atlantic City, N. J., has been awarded Lockheed Aircraft Service International. Contract runs July 1, 1958, to June 30, 1959.

Lockheed Aircraft Corp. subsidiary will also handle all aircraft modification, installation of experimental systems and photographic services on planes assigned to AMB's program of research and development with systems, procedures and devices aimed at modernizing this country's aviation facilities. Center will use all types of planes, piston-and-turbine-powered, military, commercial and private, also helicopters.

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Lead Structures Test Engineer. Engineer (M.S. preferred) with 5 years experience in structures or related field covering power controls, hydraulics or hydraulic systems, and control systems. To direct groups of engineers in work on structural aircraft elements, components and complete aircraft, including test work and report writing.

Lead Structures Engineer. M.E., A.E., or C.E., with M.S. or B.S., in Engineering with an M.S. in Math. Also, 5 to 7 years experience in any of the following: dynamic analysis, flutter and vibration, aeroelasticity, missile launching systems or structures design and testing. To direct small group of engineers in flutter and vibration studies, loads analysis, or stress analysis.

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Vought Vocabulary

e·con′o·my: *when round-trip missiles save taxpayers $102,950,000*

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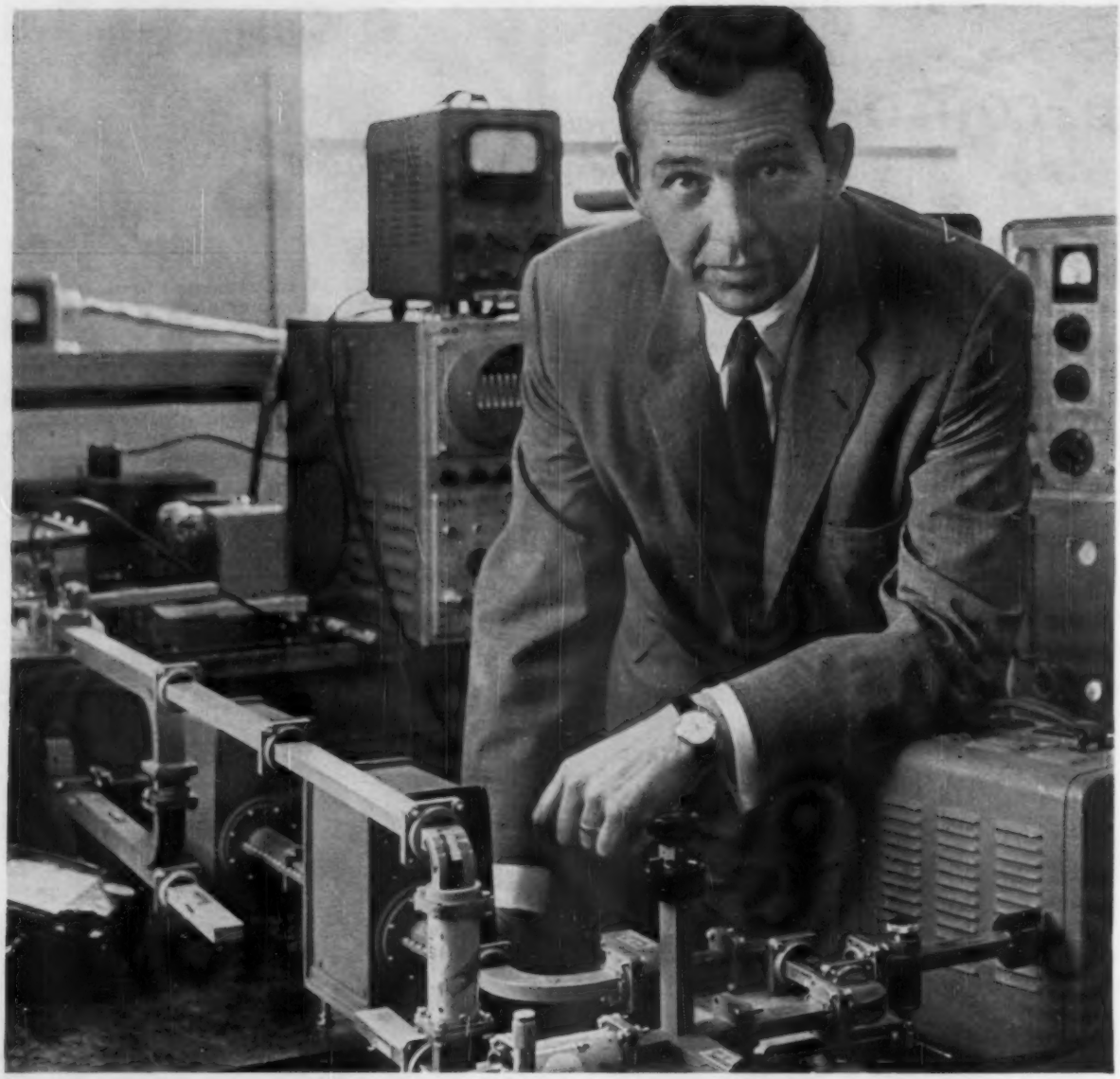

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Southwest Airmotive to Distribute Cessna Line, Grumman Gulfstream

Dallas—Southwest Airmotive Co. moved strongly into business aircraft sales recently when the fixed base operator took on distributorships for the Cessna line and the Grumman Gulfstream.

Entry into the aircraft sales field marks a considerable expansion for Southwest Airmotive's maintenance, overhaul and parts distribution operation. The company will sell the Gulfstream itself and will handle the Cessna line through Aircraft Sales Co., a recently acquired Ft. Worth Cessna distributor.

This expansion is more a matter of business opportunity than a delibrate determination to get into aircraft sales, Executive Vice President Winston Castleberry told AVIATION WEEK.

In the case of Aircraft Sales, the company had an opportunity to acquire a distributor which has done an annual business in the $2-3 million range over the past five years for a price in the neighborhood of $250,000 to $300,000. Final price depends on the disposition of such factors as accounts receivable.

Southwest Airmotive feels that Cessna has an attractive line of aircraft, so the company decided to handle it. Castleberry said that some Southwest Airmotive management policies will be installed at Aircraft Sales, but otherwise the Cessna distributor will operate as it has in the past. Aircraft Sales will sell Cessnas at Ft. Worth and Longview, Texas, and will distribute them to dealers in Dallas, Abilene, Wichita Falls and Waco.

James H. Craddock has been hired by Southwest Airmotive to promote distribution and sales of aircraft. He formerly was employed as aviation sales manager of the Humble Oil and Refining Co.

In acquiring the Cessna sales organization, the company returned to the sales field for the first time in 20 years. After an evaluation in 1938, Castleberry decided that with its limited capital, Southwest Airmotive would be better off dropping the Stinson line and concentrating on service. The company's capital position is considerably stronger now than it was then, and this was undoubtedly a primary factor in the decision to return to sales.

Capital was less a factor in the Gulfstream decision because Grumman is going to handle demonstrations, and there will be no need to maintain an airplane inventory. Southwest Airmotive will handle sales and deliveries on a commission basis. The company will sell the new turboprop executive transport throughout the U. S. along with Atlantic Aviation and Pacific Airmotive. Timmons Aircraft, Ltd., of Montreal is the fourth distributor.

Cooperative Deal

Since Grumman will deliver the Gulfstream without interior or electronic gear, Southwest Airmotive has arranged a cooperative deal with two Texas firms to turn out a finished airplane for its customers. Horton & Horton Custom Work, Inc., Ft. Worth, will provide interiors, and Associated Radio, Inc., Dallas, will install radio and electronic equipment.

Horton & Horton and Associated Radio will deal directly with the customer. They will do their work at Southwest Airmotive's Love Field base, with the fixed base operator doing the necessary airframe work to ready the Gulfstream for delivery.

Southwest Airmotive will service and maintain the Rolls-Royce Dart 7/2 engines on the Gulfstream. Since overhaul time on the turboprop powerplants is expected to be 1,500 hr., the question of overhaul won't come up for three years or so. In that period, it would be relatively easy for the company to tool up to do the job since it

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Marco Mk. 5 for light aircraft provides 90-channel transmission and 190 channels of reception between 108-126.9 m.c. utilizing crystal controls and 100 k.c. spacing in transmitter and receiver. Price is $998. Total weight including 3.5 lb. for transistorized power supply, is 9.5 lb. and measurements are 6.5 in. wide, 3 in. deep and 12 in. long, permitting two Mk. 5s to be placed one above the other in a panel cutout only one-half inch deeper than Narco Omnigator. Mk. 5 can be used with Narco VOA-3 omni converter or CS-3A or CS-5 panel-mounted navigation indicator-course selector to provide VOR or ILS guidance. Separate transmitter and receiver crystal selectors permit sending and receiving on different channels.

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already has the basic tooling and test equipment. Southwest Airmotive is overhauling military turbojet engines now and will be overhauling them for the airlines when their jets are delivered.

Company isn't particulary concerned that its expansion into the aircraft sales area might hurt sales of its parts and accessory distribution division. George W. Jalonick, III, executive vice president in charge of this operation, points out that such competitive problems already existed to some degree with competing aircraft service organizations.

Membership Splits In OX-5 Club Ballot

OX-5 Club President Russ Brinkley issued a call to the membership to cast a heavy ballot in person or by proxy at the organization's Third National Convention at Los Angeles, Aug. 7-9 to retain the present constitution and maintain current policy of the club being strictly a social organization.

Some members have proposed that the constitution be suspended during general business sessions at the convention, according to Brinkley, a founder of the club, which is composed of persons who have flown OX-5 powered aircraft. Suspension of the constitution would make possible moves on issues at the convention that would tend to change the character of the organization, Brinkley contends. He said this could lead to the club becoming a lobbying organization and claims that most members would be against such plans.

Fire-Duty Alouette Withstands Hard Use

In its first 30 days of work with U.S. Forest Service, Aetna Helicopters' Alouette II turbine-powered helicopter put in approximately 100 hr. of service while maintaining 100% availability. Maintenance problems have been practically non-existent, the operator reports; some three man hours of maintenance being spent in corrective maintenance with spare parts used in this phase comprising a single small electrically operated valve.

Two inspections were completed requiring a total of eight man hours and no replacement parts, normal pre-flight and cleaning took an additional one to two man hours per flying day. Maintenance has been handled completely by the pilot, no mechanics being available, and has averaged .53 man hours per hour of flight.

Aetna Helicopters is the first U.S. helicopter operator to use the French-designed rotary wing aircraft distributed here by Republic Aviation Corp. (AW Mar. 31, p 79).

In the course of the initial 30 days' operation, Aetna manager Robert Trimble notes that the Alouette has been picking up cargo weighing 500-600 lb. at density altitudes of 9,000 ft. to 12,500 ft., exclusive of pilot and fuel. During its Forestry Service contract the helicopter has handled over 175 flights on fire control at altitudes ranging from 7,000 ft. to 10,000 ft. On each trip the machine returns with two fire jumpers plus their equipment, which averages 100 lb. a set. Up to 32 such missions are flown daily.

Available data on the operation shows that the Alouette has carried 56,623 lb. of cargo, 214 passengers, made 246 flights and used 3,600 gal. of fuel.

Australians Improve Pasture

Large aerial pasture improvement project on Glenrock Station, some 200 mi. north of Sydney, Australia, is utilizing a fleet of Edgar Percival E.P. 2 agricultural aircraft to sow and fertilize approximately 35,000 acres in the area. The specially designed E.P. 9s have 2,100-lb. hoppers, carry average loads of 1,900 lb. at 3,400-ft altitudes. Photo above shows one of the Skyspread E.P. 9s dispensing seed and phosphate at low altitude. Photo below shows a plane receiving seed from self-propelled loading equipment.

European Countries Form Ag-Plane Pool

Paris—Nine countries have organized the European Agricultural Aviation Center to promote cooperation and greater efficiency in the use of aircraft. Initial meeting of the group, sponsored by the Organization for European Economic Cooperation was held in Paris last month. Center has headquarters in The Hague.

The Center hopes that it can develop pooling of aircraft in its area to provide more effective and less costly operations. There are some 200 agricultural aircraft based in OEC territory. Members of the Center include Denmark, France, Germany, Italy, The Netherlands, Sweden, The United Kingdom, Spain and Yugoslavia.

PRIVATE LINES

Morane-Saulnier MS-760 Paris twin-jet executive plane received Civil Aeronautics Administration type certificate. Beech Aircraft, which has distribution rights for MS-760, will import two of the airplanes this year, one going to Timken Roller Bearing Co.

Corporate name of Hiller Helicopters has been changed to Hiller Aircraft Corp. to reflect the company's continuing diversification.

Federal autopilot has been CAA-approved for Cessna 172, 180, 182 and Skylane.

Okanagan Helicopter Group is providing three Sikorsky S-55s and crews on an annual contract basis to work for Federal Electric Co., Paramus, N. J., on Dew-Line construction and maintenance. . . . Okanagan also has renewed its contract with Department of Fisheries, Ottawa, Ont., for operation of a Sikorsky S-55 and a Bell 47, moving personnel, freight and serving remote outposts in Newfoundland.

Timken Roller Bearing Co.'s Executive B-25 has been fitted with a Lear Integrated Flight Equipment display at AiResearch Aviation Service, Los Angeles International Airport.

Gibbons-O'Keefe Air Charter, Chicago, has been licensed by Canadian Air Transport Board to operate international nonscheduled charter service to Winnipeg, Kenora, Toronto and Montreal with aircraft of less than 6,000 lb. payload.

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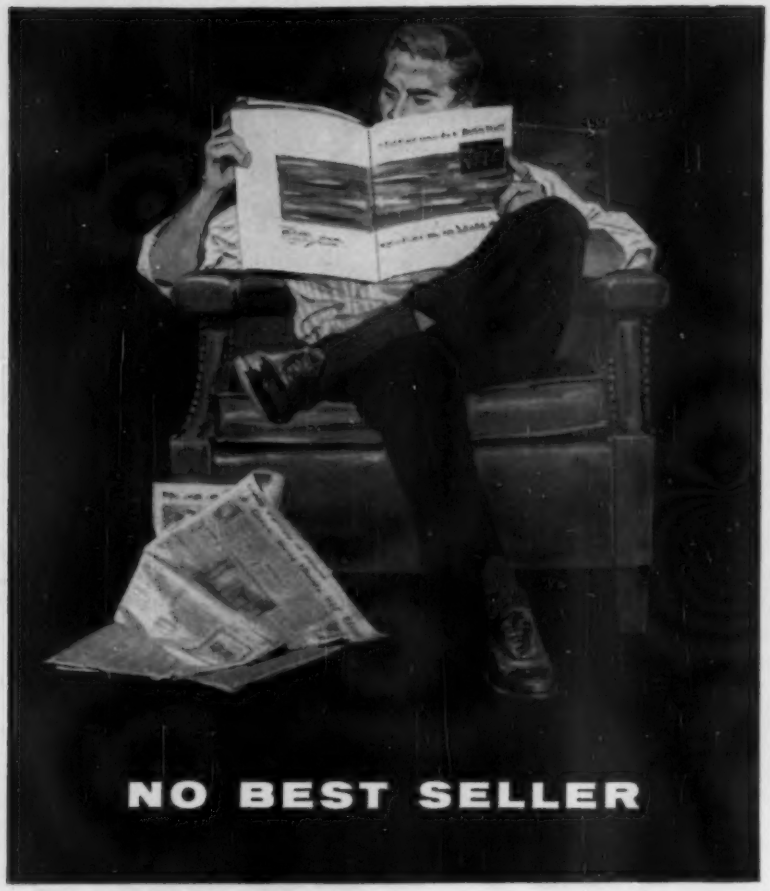

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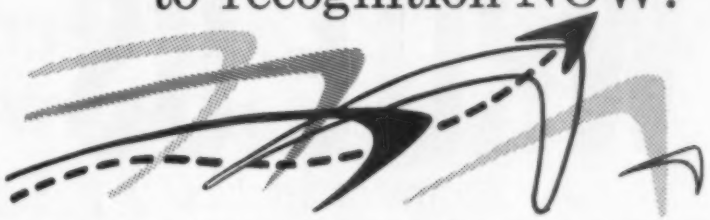

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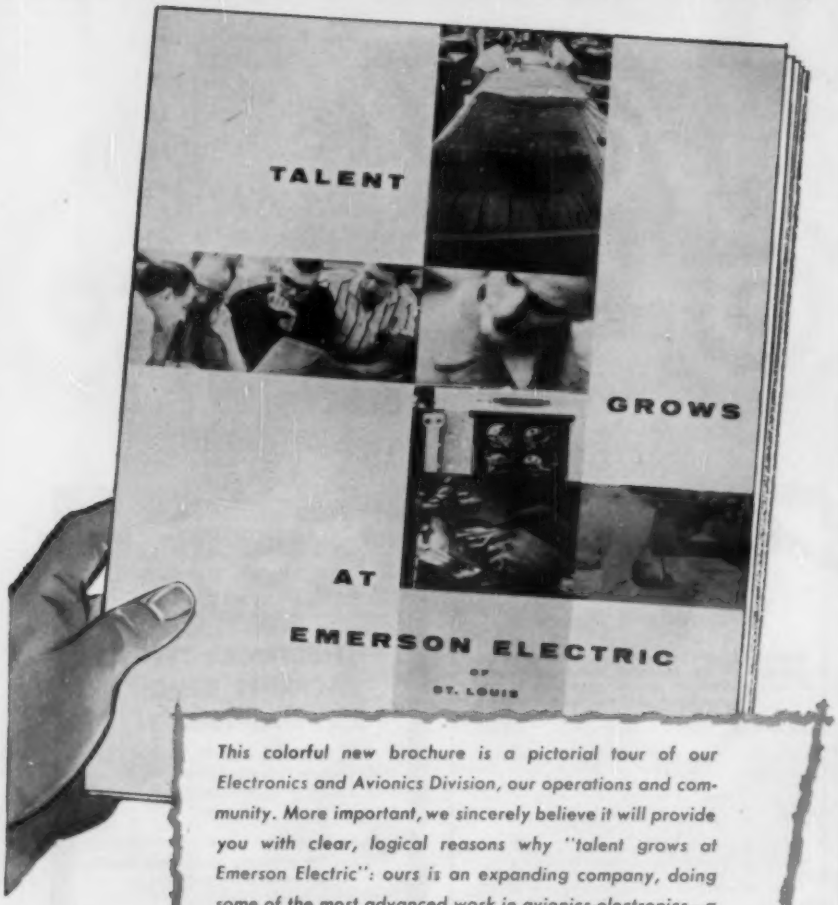

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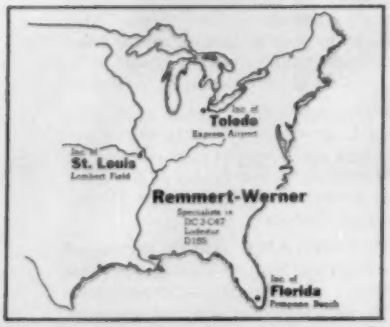

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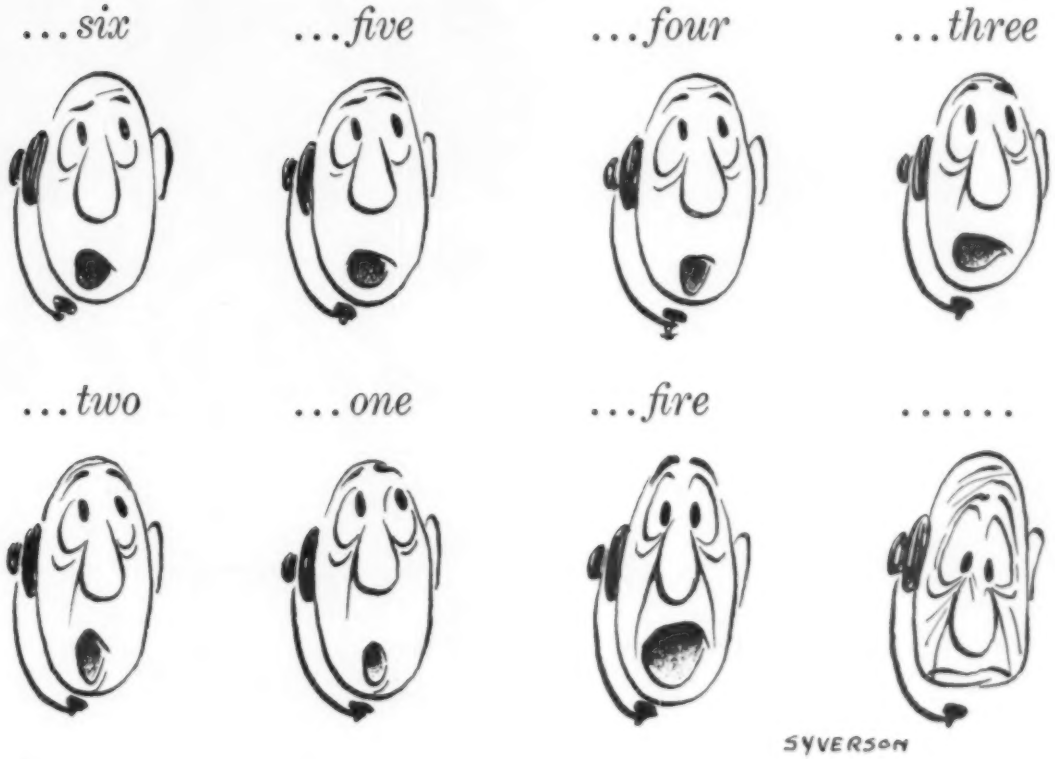

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Missile men desiring a special reprint of the above cartoon should write to "Count-down", c/o Inet Division of Leach.

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LETTERS

Limited Edition

The writer is acting as the agent for a group of engineers who have contributed toward this subscription out of frustration. We have one copy of AVIATION WEEK come into our office (The Aerial Reconnaissance Laboratory, Wright Field, Ohio) for over 200 engineers. If you are acquainted with the quaint habits of government offices you will appreciate why this subscription is for a private home address which will see that AVIATION WEEK reaches those who are sufficiently interested to contribute toward this subscription.

Dayton, Ohio

Stringent Requirement

Congratulations on a fine issue (June 16, Research for Space Edition). We found it most informative and were pleased to note that we are considered typical of firms active in the development of accessory power sources for space vehicles.

But, in deference to others in the industry, we would like to correct the erroneous conclusion drawn on pp. 237 and 239.

Although we are not yet at liberty to disclose the correct application, the equipment pictured and described was never intended for the Atlas vehicle. The 30-min. operating cycle apparently misled the author, since this is within the commonly accepted order of magnitude for ICBM flight. However, this was just one challenge in the development of a long-mission APU. Cycles in excess of 12 hr. or more, without maintenance, now appear to be feasible.

It may be of interest to note that this unit has recently completed 300 cycles of endurance testing, a rather stringent requirement even for a machine with the reliability requirements of Atlas.

PAUL SCHRATTER
Manager, Product Information
Aircraft Accessory Turbine Dept.
General Electric Co.
West Lynn, Mass.

Viscount Controls

Your article in the June 9 issue (p. 72) titled "Flap Bolt Failure Caused Viscount Crash" was shocking. The investigation of the crash was very thorough, and the analysis of all details most complete. I heartily agree with the engineering recommendations for corrective action—as far as they go.

It is inconceivable that the actual cause of this crash could be so completely ignored. The flap bolt failure most certainly was not the cause. Investigation proved that the aircraft could easily have been controlled had the ailerons been operative, despite malfunction of the flaps. The actual cause of the crash was the lockup of the ailerons and other control surfaces, caused by fouling of the cables used in the ground lockup system for all Viscount control surfaces. True, this lockup cable was fouled due to a series of events, and subsequent flap bolt failure, but the fact remains that the aircraft could have been safely landed if the control surfaces had been operative.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

The thought then occurs, where else in this aircraft could some minor difficulty occur in such a manner that the control system might become fouled? Is the routing of these cables through the fuselage to the tail surfaces such that, regardless of what might occur, these cables could not possibly foul? The hazard of a mechanic's glove or a rag carelessly left in a vital area and fouling the cable thereby locking the control surfaces has not been considered, if the investigation report is complete.

In my opinion, the most vital correction indicated by this investigation is the deletion or modification of the control surface locking system. A control column and rudder pedal locking device contained completely within the cockpit is obviously the safest type, although perhaps not so neat in appearance as its hazardous cable type counterpart.

If Vickers insists on using cables for locking control surfaces, it is suggested that each control surface locking device be spring loaded to the "lock" position, requiring a tension on the cable for unlocking. In the event of a cable fouling, the additional pull on the cable would be in the direction of the unlocked position. Should a cable break, only one control surface would lock up, leaving the crew a fighting chance to control the aircraft with the other control surfaces remaining operative.

The attitude of the investigating group to the pilot's suggestion to move the lock cable fairlead off of the flap structure was most shortsighted.

The control surface locking system was the major cause of this accident, and a complete redesign of the system should be required immediately. If the British cannot see the danger of this cable locking system, perhaps our CAA might see fit to take a long look at the Viscounts flying in the United States, and take the necessary steps to eliminate this dangerous condition.

JOHN S. HAHN
Liaison Engineer
Rohr Aircraft Corp.
Chula Vista, Calif.

(The report was taken from the official British Ministry of Transport and Civil Aviation, Civil Aircraft Accident, Report of The Court Investigation.—Ed.)

Simplifying Monitor

The takeoff monitors described in the June 23 issue (p. 65) seem unduly complicated by the use of accelerometers which require correction for pitch attitude.

Sufficient information can be derived from an odometer consisting of a light source and a semiconductor photocell mounted on a main gear strut and focused through a slit on four equally spaced white stripes painted on the inner sidewall of a main tire. Pulses generated in this way could trigger a single shot multivibrator or other pulse shaper to give short pulses of definite energy content, which may be bucked against a clockwork driven increasingly direct current indicating desired acceleration.

The difference current through a polarized relay with sufficient inertia to hold during the chopped up wave form, would then activate the no-go alarm when the increasing d.c. energy predominated during some interval. The clockwork rheostat could have a compensating taper for high speed drag and would be started by the first pulse. The absolute value of the d.c. would be set up from a hand computer, compensating for weight, temperature, gradient of runway, etc.

If the pulse rate was divided down by a factor of four, it would be within the range of a conventional pulse-stepping motor for speeds up to about 120 kt., so that distance covered and distance to point of refusal might be shown directly. The motor might also move a bug around the airspeed dial to give distance-airspeed indications at a glance.

In this way the problem of a built-in odometer as well as accelerometer correction could be solved.

LEO MACKTA
Belle Harbor, N. Y.

IBM Computer

The article pertaining to ground support equipment for the Thor IRBM (June 2, p. 40) states that an IBM Type 703 automatic computer is part of the support equipment. Actually, it is the IBM Type 704, not the 703, which is used with the Thor.

ROBERT M. BLAKESLEE
Saugerties, N. Y.

Technical Selling

Mr. Charles E. Casad's letter entitled "Idea Salesmen," (AW May 19, p. 114), very capably expresses my sentiments on the subject. Engineers as a whole do not know how to effectively sell their ideas. Cautious, detailed, and boring presentations, both verbal and written, are all too common. Engineering is an exciting business, and basically most engineers know this. But to hear them tell about it makes the occupation sound very dull.

To help overcome this, the engineering colleges must give more attention to courses in technical salesmanship. Another help would be energetic training programs in idea selling, supported or sponsored by firms employing engineers.

I have one point of contention with Mr. Casad. He states, "Accuracy of statement is of no concern to him (the salesman) . . ." This implies that honesty may be lacking in the salesman's approach. On the contrary, the good salesman will keep on selling. And to do so he must be accurate—not detailed, but accurate.

JOSEPH H. ANDREWS
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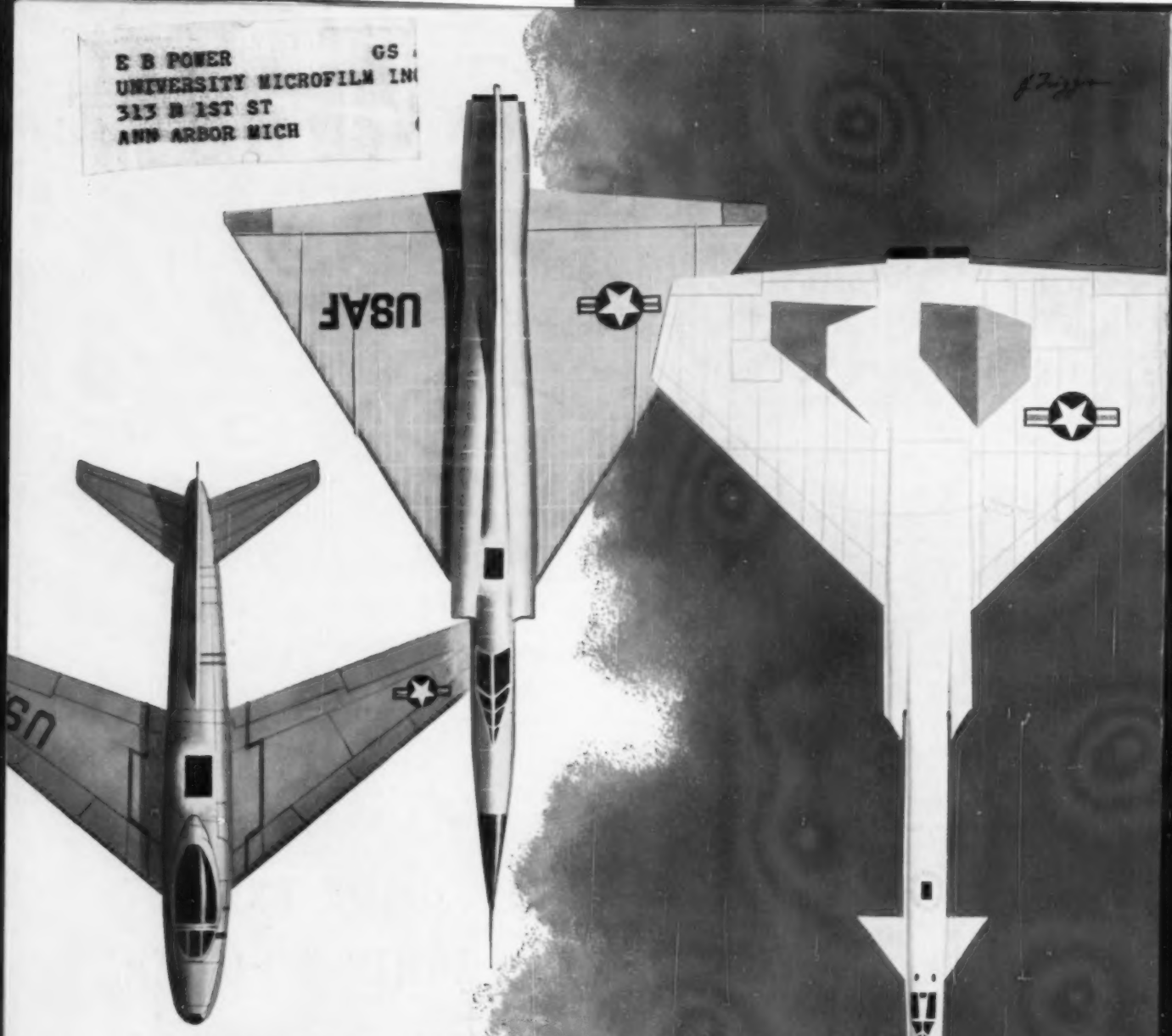

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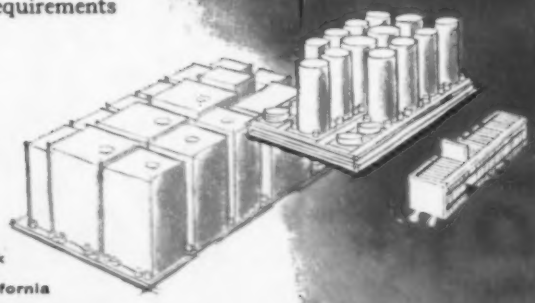

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